# Chapter Three: Habitat, Fish and Wildlife

**Contents**

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## A. Habitats

Habitats that support natural resources of the sale area include offshore marine and estuarine waters and onshore coast lands. These habitats host numerous specie communities of plankton and marine invertebrates and tundra. Species higher up in the food chain that depend on these habitats are described in Section B of this chapter.

### 1. Coastal Zones

The entire sale area is located within the coastal zone. The coastal zone is divided into three regions, depending on the level of interaction and influence with the Beaufort Sea coastal environment. They are the zone of direct interaction, the zone of direct influence, and the zone of indirect influence (ACMP, 1985).

The zone of direct interaction is defined by the inland extremes of wave impacts, saltwater intrusions in soils, ground water flows, and the area of active coastal erosion. This zone includes estuaries and deltas inland to a point where tides no longer influence water flow and quality characteristics. This zone includes areas where vegetation is influenced by sea spray; on average as far as two to three miles inland. Stream slope and freezing action in winter generally determine the distance at which saltwater reaches upstream. The seaward extent of the zone of direct interaction is located at the winter shear zone, where shorefast ice meets the Arctic ice pack. At this interface, pressure ice ridges build and large ice flows drift into shallower waters; this results in extensive ice scouring of the bottom; especially between the 59 and 88-feet isobaths (ACMP, 1985).

In summer, longshore sediment drift and breaking waves play a direct role in shaping coastal landforms. This zone includes the barrier island lagoon habitat, characterized by low salinity due to freshwater run off. In the spring, the ice cover melts away from the shoreline, and light penetrates the water column. As summer progresses, ice melt and freshwater run off reduces salinity, and temperatures and oxygen levels increase in the protected lagoons providing ideal conditions for phytoplankton and zooplankton growth. Nutrients from coastal erosion and river run off fortify the system. This estuarine habitat is protected from colder, more saline waters, and is important for migrating and feeding saltwater intolerant fish. The coastal zone provides important spawning habitat for marine fish and invertebrates. These creatures in turn provide waterfowl and marine birds with a plentiful source of food (ACMP, 1985).

Beyond direct interaction lies the zone of direct influence. This zone ranges from the inland extent of optimum waterfowl and shorebird nesting habitat, and polar bear denning sites (25 to 30 mi.) to about 50 miles offshore; on the edge of the continental shelf. At the shelf edge, cold, saline, nutrient rich water upwells, facilitating marine food production and supporting populations of all species up the food chain, including seabirds, beluga, and bowhead whales.

The zone of indirect influence includes the geographic range of migratory animal species, which depend on the barrier island lagoon system and shores of the Beaufort Coast. For example, bowhead whales wintering in the North Pacific are influenced by the availability of food in their preferred summering habitat in the eastern Beaufort Sea. In summer, sea ice retreats from the barrier lagoons allowing for algae blooms to persist throughout the long daylight hours of the three month ice-free season. Shorebirds arrive and nest along the Beaufort coast and utilize the islands for rearing young.

The zone also includes all rivers flowing into the Beaufort Sea, and the upland extent of anadromous fish populations. It also includes at a minimum, the extent of coastal wet tundra habitat; a range roughly corresponding to the 200-foot contour (ACMP, 1985). Principal rivers flowing through or into the sale area include the Kogru, Kalikpik, Tingmeachsiovik, Colville, Kachemach, Miluveach, Ugnuravik, Sakonowyak, Kuparuk, Putuligayuk, Sagavanirktok, Kadleroshilik, Shaviovik, Staines, and Canning.

## 2. Plankton and Marine Invertebrates

Phytoplankton are the plant life of the sea upon which all marine life are sustained. They are the food source for shellfish and invertebrates, and small animals, called zooplankton. Plankton are essentially free-floating creatures, whereas zooplankton have some motility in the water column. The bowhead summer feeding region off the Canadian Arctic depends on phytoplankton production.

Phytoplankton in the Beaufort Sea includes diatoms, dinoflagellates, and flagellates with the diatom *Chaetoceros spp*. being the most abundant. In studies done in Harrison and Prudhoe Bays, flagellates were most numerous at the surface with diatoms most numerous in the water column. Primary productivity was highest not at the surface, but in the water column where diatoms were the most abundant organism. The spatial (horizontal) distribution of diatoms in waters close to shore and river mouths suggest that light levels, rather than salinity or temperature determine diatom distribution (Horner, 1984).

Phytoplankton production gradually increases after ice break-up, when light becomes available. Then it declines after September when light availability limits photosynthesis. During the bloom period, zooplankton graze on a changing phytoplankton community as spring dominant species are replaced with summer species and so on (Horner, 1984). Primary productivity in the Beaufort Sea is low compared to southern waters (NSBCMP, 1984a). Primary productivity of the Beaufort Sea has been estimated at up to 30 grams of carbon per square meter per year (MMS, 1996a). Productivity in Harrison Bay and Simpson Lagoon has been measured at 10 to 23 grams, and less than 10 grams per square meter in Prudhoe Bay. Primary productivity values can fluctuate as much as three-fold from year to year (Horner, 1984), which may affect population dynamics for species higher up the food chain.

Zooplankton abundance and species diversity appears to increase with increasing distance from shore. One species group prefers deeper, more saline oceanic water offshore and includes *Mysis litoralis, Parathemisto abyssorum, Hyperia galba, Calanus hyperboreus, C. glacialis, and C. hydromedusae*. A second species group prefers lower salinity barrier island lagoons and includes *Mysis relicta, Monoculodes crassirostris, Onisimus glacialis, Acanthostepheia incarinata, and Pontoporeia affinis*. A third species group is transitional, preferring shallow offshore waters, and this community includes species of the other two groups (NSBCMP, 1984a).

Larger invertebrate communities in the nearshore lagoons include animals living in the bottom (infauna), animals usually living on or near the bottom (epibenthic), and those which live in the water column (pelagic). In Simpson Lagoon, infauna are restricted to depths greater than 2 meters, because shallower portions freeze solid during winter. These include polychaete worms (*Ampharete vega and Terebellides stroemi*) and bivalves (*Cyrotidaria kurriana*). Epibenthic creatures include amphipods, mysids, and isopods. Pelagic species include copepods and chaetognaths; important food sources for anadromous fish. During winter, epibenthic and pelagic species disappear, and then emerge again in spring, whereas infauna and some amphipods may be present year-round (Craig, et al., 1984). These creatures are an important source of food for birds and marine mammals.

Arctic kelp (macroalgae) coexist with a large invertebrate community in Stefansson Sound, with *Laminaria solidungula* as the most dominant species present. In contrast, shallow water and a lack of rocky substrate prevent Arctic kelp from surviving in Simpson Lagoon (Craig, et al., 1984). This marine plant endures nine months of darkness, but grows fastest in late winter and early spring due to higher concentrations of inorganic nitrogen in the water column. Sediments trapped in the ice above the kelp block light and restrict growth, however the presence of leads and cracks has the opposite effect. Kelp make up between 50 and 55 percent of the available carbon in the Stefansson Sound kelp community, while phytoplankton make up between 23 and 42 percent. This ratio has been linked to the level of sediments on the surface in a given year. The consumers of this carbon include filter feeding invertebrates like the chiton, Amicula vestita (Dunton, 1984). Arctic kelp is suspected to occur in other portions of the sale area including east of Belvedere and Flaxman Islands, near Konganevik Point in western Camden Bay, in Nuvagapak Lagoon, and in Demarcation Bay (MMS 1998b; citing to Dunton et al, 1982).

# 3. Vegetation

Most onshore vegetation consists of tundra. Species composition of tundra depends on factors including availability of moisture, presence of saltwater and proximity to the seacoast, and slope (AEIDC, 1975).

The tundra surface is marked by swamps, lakes, thaw ponds, frost cracks, and polygonal ground formations. Successive freezing and thawing of moisture laden soils causes frequent draining and reforming of lakes and surface peat (AEIDC, 1975:36). The soil beneath tundra freezes each winter, thaws in spring, and is saturated with salt or fresh water throughout the summer. The freeze-thaw process causes these lakes to reform each year. Tundra and grasses of the barrier islands are also exposed to freeze-thaw processes.

Several species of sedges (especially *Carex aquatilis*) make up much of the vegetation community. Secondary species include common names of cottongrass, lousewort, and buttercup in the wetter sites, and heather and purple mountain saxifrage in the raised drier habitats (AEIDC, 1975:122).

Waterbirds depend on or prefer certain habitat types, and attempts have been made to rank the value of these habitats, especially on the Colville River. Concern over wetland loss from gravel filling associated with oil and gas development and its effects on migration, nesting, and brood rearing, drives classification studies. Bergman et al. (1977) identified eight wetland designations (See Table 3.1)

### Table 3.1 Wetland Designations

| Class Designation | Cover type |
|---|---|
| Class I. Wetland Tundra | Wet sedge meadow, sedge, willow |
| Class II. Shallow-Carex | Wet sedge meadow, sedge, willow |
| Class III. Shallow-Arctophila | Wet grass-sedge meadow |
| Class IV. Deep-Arctophila | Wet grass-sedge meadow, Discrete lake |
| Class V. Deep-open | Discrete lake, Tapped lake |
| Class VI. Basin-complex | Wet sedge meadow |
| Class VII. Beaded streams | Barren |
| Class VIII. Coastal wetlands | Midgrass-herb, halophytic sedge, halophytic grass-sedge, halophytic herb |

From Meehan & Jennings, 1988.

Meehan and Jennings (1988) studied the distribution and behavior of birds on the Colville Delta, and derived nine habitat classes for large waterbirds (Tundra swan, Greater white-fronted goose, Pacific loon, Yellow-billed loon, and brant):

- Discrete Lake habitat includes lakes and estuarine waterbodies, similar to Bergman's Class V.
- Tapped Lake habitat includes lakes that are hydrologically connected to a river system. In spring, flooded channels breach these lakes, allowing sediments and salt water to infiltrate. This class is also similar to Bergman's Class V.
- Wet-Moist Flooded Tundra includes wet sedge polygonal ground (Bergman's Class I) and moist sedge willow (Bergman's Class II).
- Wet Graminoid habitat is found along lake shores and polygonal ponds. Similar to Bergman Classes III and IV, the largest stands on the Colville Delta are located in its southcentral portion (located within the sale area). This habitat includes dominant species, *Arctophila fulva* and *Carex aquatalis.*
- Wet-Moist Polygons include moist to wet low tundra meadows; near lake ponds and margins, flooded basins, and polygonal ground. Similar to Bergman Classes I and II, this habitat is the most abundant vegetation cover on the Colville Delta. This vegetation type was used by Pacific and Yellow-billed loon nesting and Tundra swan and white fronted geese.
- Brackish Flats, similar to Bergman's Class VIII, is found along the fringe of the delta, river channels, and tapped lakes. This habitat type has been associated with high brant use.
- Shrub Dominant Areas consist of low willow communities on river banks, terraces and dunes. Most bird use was low, and there was no equivalent Bergman class.

- Barrens includes partially vegetated dunes, grass-forb lake shore, and partially vegetated and unvegetated floodplain. Similar to Bergman's Class VIII, this habitat is of low use by most birds and covers about 30 percent of the Colville Delta's total area.
- Sedge-Tussock Tundra, found in the western part of the delta, has no comparable Bergman class.

Meehan and Jennings (1988) ranked the importance of habitat classes relative to usage by key bird species. Discrete lakes were used the most, followed by Wet-Moist Polygons, Brackish Flats, Wet Graminoid, and Wet-Moist Flooded Tundra. Tapped lakes and Shrub Dominant areas received an equal amount of use after the top six, followed by Sedge-Tussock Tundra and Barrens which were used the least. The authors caution that although the classes may apply to habitats across the North Slope, the ranking should only be applied to the Colville River Delta.

In a remote sensing study of Snow goose brood-rearing habitat on the Sagavanirktok River delta, Burgess and Ritchie (1988) followed the classification scheme of Walker and Weber (1980) to derive a similar habitat classification (See Table 3.2)

**Table 3.2 Snow goose brood-rearing habitat classification**

| Plant Community | Description | Dominant plant species |
|---|---|---|
| Moist Graminoid | moist upland sites, dry low-centered polygons and polygon rims | *Carex aquatalis, Dryas integrifolia, Salix arctica* |
| Wet Graminoid | wet areas in sand dune regions | *Carex aquatalis, Dupontia fischeri, Salix ovalifolia* |
| Wet Coastal Saline Graminoid | coastal estuaries and lagoon area normally flooded with salt water part of the year | *Carex subspathacea, Dupontia fischeri, Eriophorum angustifolium* |
| Very Wet Graminoid | pond and lake margins | *Carex aquatalis, Arctophila fulva* |
| Dry Coastal Bluff Barrens | coastal bluffs and ridges | *Dryas integrifolia, Sedum rosea* |

From: Pollard, et al, 1992:4

More complex vegetation classification systems have been developed for oil and gas development proposals. For example, in the Alpine Development Project, habitats on the Colville Delta are described with 24 habitat types; a system developed by Viereck, et al.(1992) and modeled after Cowardin, et al. (1979).

Regardless of the habitat class system used in planning, the important points to consider are which plant species are associated with various life stages of important animals (feeding, nesting, incubation, brood rearing, etc.), and what is the most appropriate and practical way to identify those habitats. For caribou, some plant species may provide greater nutritional value for migrating, gestating, and new born animals. The following section discusses the sale area's fish and wildlife with references to key supporting habitats.

# B. Fish and Wildlife Species and Their Habitats

## 1. Fish

Fish species likely to be found in or near the sale area waters are listed in Table 3.3. Anadromous fish-bearing streams flowing through or into the sale area include the Aichilik, Hulahula, Okpilak, Kogotpak, Egaksrak, Kongakut, Aichiklik, Canning , Staines, Shaviovik, Sagavanirktok, Kuparuk, Colville, Fish Creek, Kogru, Ikpikpuk, Alaktak, Chipp, Topagoruk, and Meade rivers.

The Colville is the largest river draining into the sale area. The Colville River supports an abundance of fish, composed of at least twenty species, the dominant species being whitefishes and ciscos. Other species found in the Colville River include chinook, chum, and pink salmon; Dolly Varden char, and Arctic grayling. Like other North Slope rivers, the Colville River discharges warm freshwater into the Beaufort Sea, forming a zone of warm brackish water along the coast. This zone of brackish water is an important factor affecting the distribution and abundance of all Beaufort Sea fish because of its importance to anadromous fish for feeding

and migrating. Freshwater fish species are found in lakes and the Colville River. These species include arctic grayling, round whitefish, non-migratory arctic char, burbot, ninespine stickleback, slimy sculpin, and lake trout (See Figures 3.1.A - C).

Nearshore waters and lagoon systems provide migration corridors and important feeding habitat for these anadromous fishes (USDOI, 1987). The warmer nearshore waters contain an abundance of amphipods, isopods, euphausids, coelenterates, and chaetognaths (Gertler, 1988) which provide important food sources for anadromous fish in marine waters.

### Table 3.3 Fish in the sale area

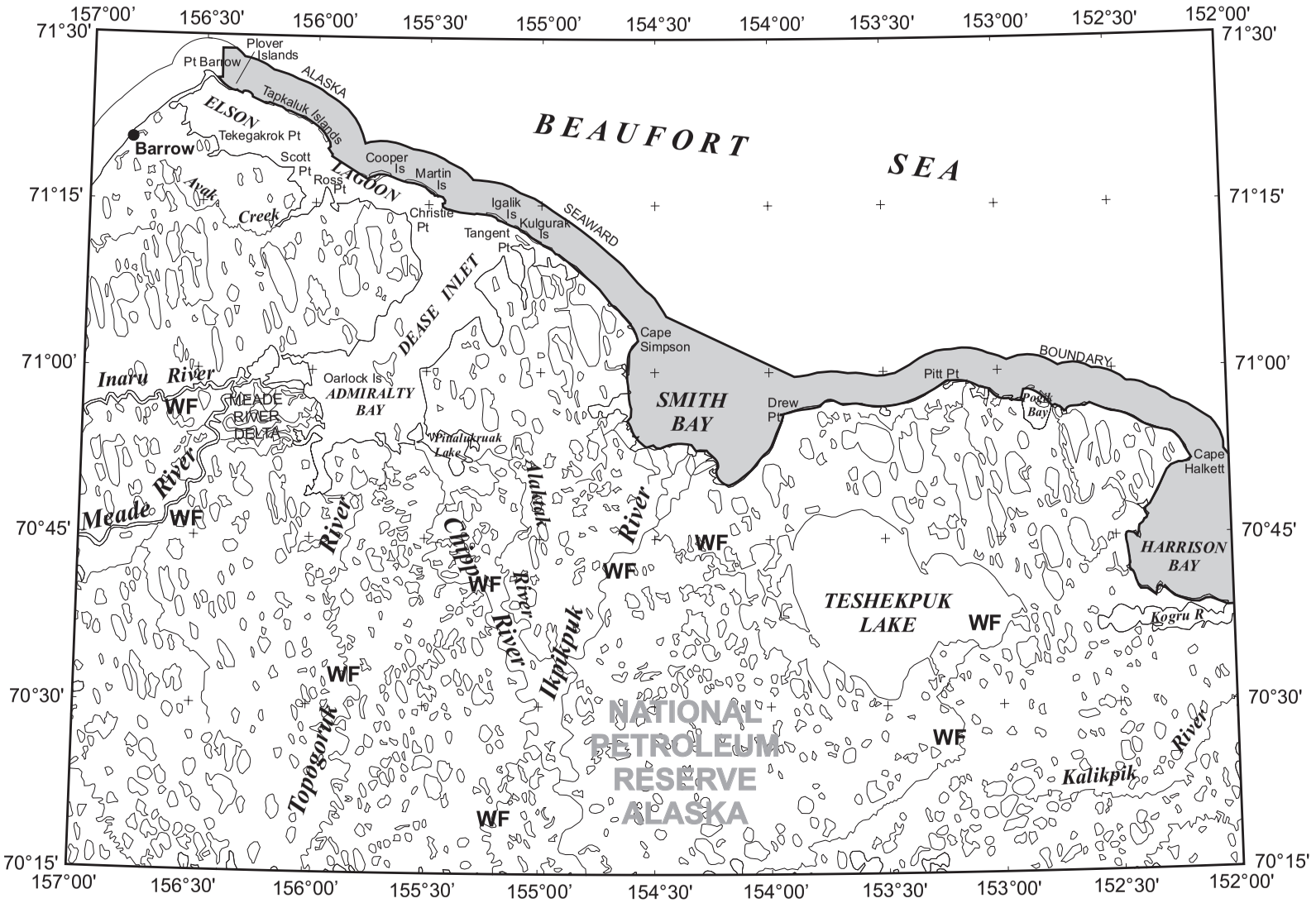
| Anadromous or Resident | | Marine | |
|---|---|---|---|
| Common name | Scientific name | Common name | Scientific name |
| Arctic char | *Salvelinus alphinus* | Arctic flounder | *Liopsetta glacialis* |
| Dolly Varden | *Salvelinus malma* | Starry flounder | *Platichthys stellatus* |
| Arctic cisco | *Coregonus autumnalis* | Arctic cod | *Boreogadus saida* |
| Least cisco | *Coregonus sardinella* | Saffron cod | *Eleginus gracilis* |
| Bering cisco | *Coregonus laurette* | Capelin | *Mallotus villosus* |
| Broad whitefish | *Coregonus nasus* | Snailtish | *Liparus sp.* |
| Humpback whitefish | *Coregonus pidschian* | Pacific sandlance | *Ammodytes hexapterus* |
| Chum salmon | *Onchorynchus keta* | Pacific Herring | *Clupa harengus* |
| Rainbow smelt | *Osmerus mordax dentex* | Slender eelblenny | *Lurnpenus fabricil* |
| Boreal smelt | *Osmerus eperlanus* | Stout eelblenny | *Lumpenus medius* |
| Ninespine stickleback | *Pungitius pungitius* | Eelpout | *Lycodes spp.* |
| Threespine stickleback | *Gasterosteus aculeatus* | Arctic sculpin | *Myoxocephalus scorpioides* |
| Pink salmon | *Onchorynchus gorbuscha* | Spotted Snailfish | *Liparus callyodon* |
| | | Sculpin | *Myoxocephalus sp.* |
| | | Saffron Cod | *Eleginus gracilis* |
| | | Fourhorn sculpin | *Myoxocephalus quadricornis* |

Anadromous fish typically leave the rivers and enter the nearshore waters of the Beaufort Sea during spring break-up, from mid- to late-June. They initially occupy open water leads nearshore before dispersing along the coast to feed as the ice cover melts and recedes. Small fish tend to remain near overwintering rivers such as the Colville, while larger fish may migrate distances of 80 miles or more in search of feeding habitat. Migration back to rivers varies by species, but most anadromous fish return to freshwater, where they spawn, by mid-September (ADNR, 1991:13).

As with most anadromous fish species, whitefish spend much of their life cycle in salt water. They feed in salt water during the summer, but unlike other anadromous fish, generally remain in freshwater plumes extending out from river mouths and in marine waters of lower salinity. As with arctic char, these species move up river around mid-August and spawn in late September or October (Rogusky and Komarek, 1971).

Least cisco and arctic cisco are among the most abundant anadromous fish captured in the Prudhoe Bay and Sagavanirktok Delta areas. They inhabit the nearshore environment and spawn in the fall. The Colville River is a major overwintering area for cisco. During the ice-free period cisco undertake extensive migrations through the nearshore area (NSBCMP, 1984a:1-194).

Non-anadromous fish inhabit freshwater year-round. Virtually all Arctic grayling are found exclusively in freshwater throughout the year (Ott, 1997). Dolly varden and broad and humpback whitefish remain in freshwater for several months or years, depending on the species, before migrating to coastal waters, returning to inland waters to spawn and overwinter (ADNR, 1990:25). A lack of overwintering habitat is the primary factor limiting arctic fish populations. Rivers freeze to the bottom over much of their length, therefore only the deeper sections are available for overwintering habitat (Sousa, 1992:2). The Colville River provides the most consistently available overwintering habitat (Baker, 1987:1-8).




3-6

## Important Anadromous Fish Habitat


| Arctic Char/Dolly Varden | Arctic Cisco | Whitefish | Least Cisco | Sale Area |
|---|---|---|---|---|
| AC | ACI | WF | LCI | |

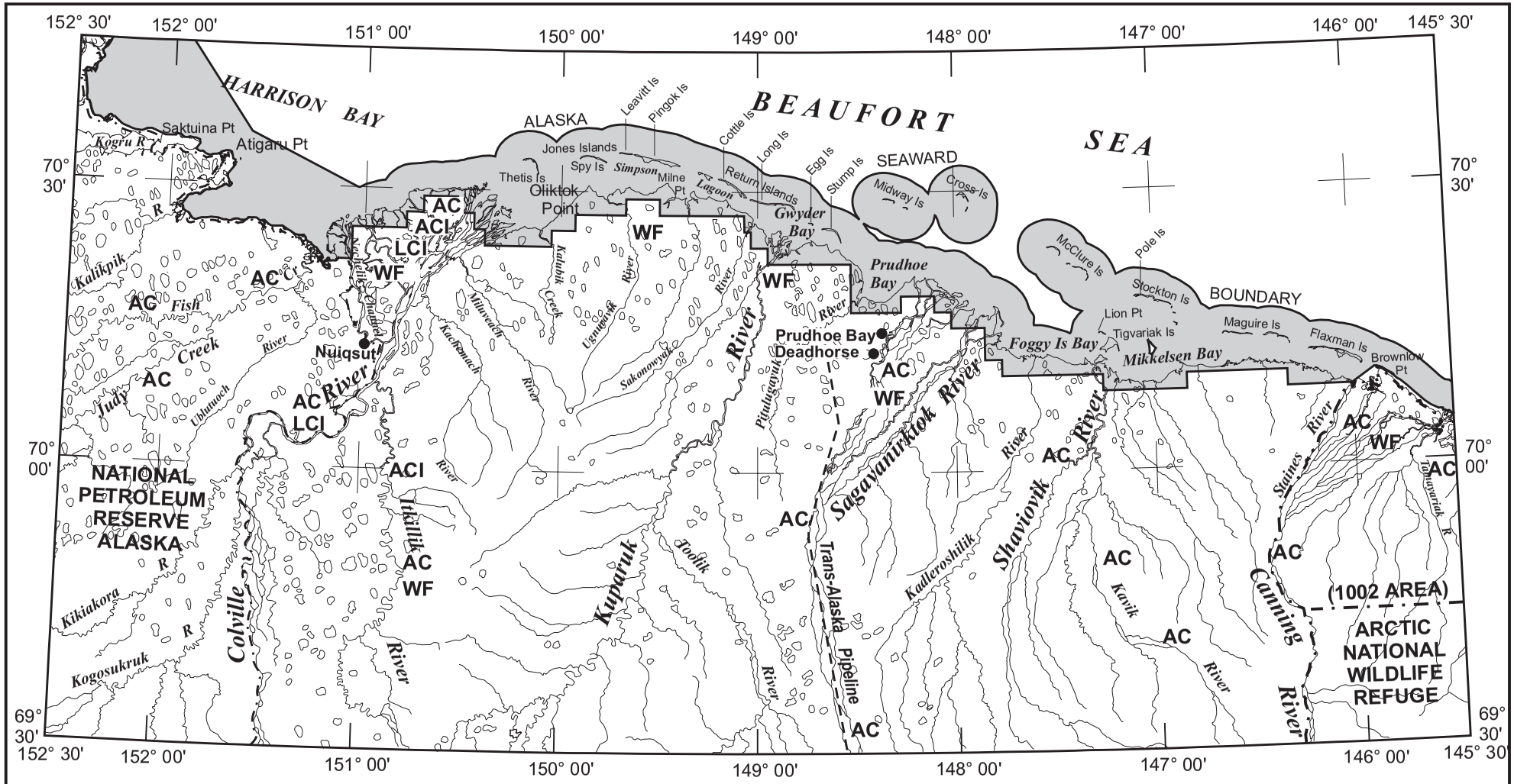
Adapted From: NSBCMP, 1984b. ADF&G, 1986, 1996.

SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.

20 MILES 0 20 40 MILES

ADNR 5/7/99

**FIGURE 3.1.A**




## Important Anadromous Fish Habitat

| Arctic Char/Dolly Varden | Arctic Cisco | Whitefish | Least Cisco | Sale Area |
|---|---|---|---|---|
| AC | ACI | WF | LCI | |

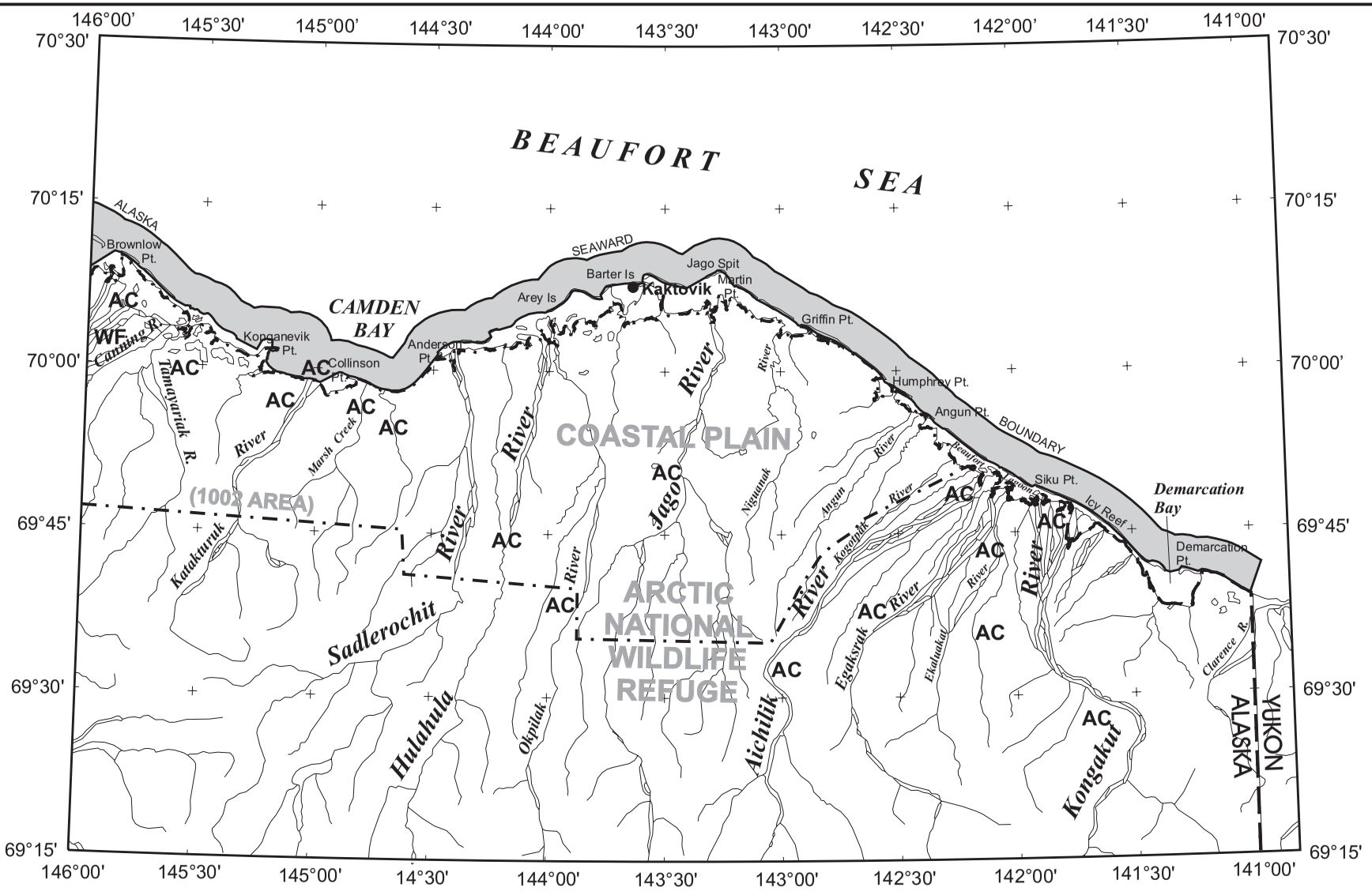

Adapted From: NSBCMP, 1984b. ADF&G, 1986, 1996.

SCALE 1:1,100,000 ONE INCH = 18 MILES APPROX.

20 MILES 0 20 40 MILES

ADNR 5/7/99

**FIGURE 3.1.B**




## Important Anadromous Fish Habitat


Arctic Char/Dolly Varden **AC**

Arctic Cisco **ACI**

Whitefish **WF**

Least Cisco **LCI**

Sale Area

Adapted From: NSBCMP, 1984b. ADF&G, 1986, 1996.

SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.

20 MILES 0 20 40 MILES

ADNR 5/7/99

**FIGURE 3.1.C**

Marine species in the Beaufort Sea have been studied much less than anadromous species. In general, they appear to be widely distributed but in fairly low densities, with schooling species, such as arctic cod, displaying a rather patchy distribution. The most widespread and abundant species are the arctic cod, saffron cod, twohorn and fourhorn sculpins, the Canadian eelpout, and the arctic flounder (MMS, 1987: III-22).

Some marine species, such as arctic cod and capelin, sporadically enter the nearshore areas to feed on the abundant epibenthic fauna or to spawn. Others, like fourhorn sculpin and flounder, remain in coastal waters throughout the ice-free period, then move farther offshore with the development of the shorefast ice during the winter. The arctic cod has been described as a key species in the ecosystem of the Arctic Ocean due to its widespread distribution, abundance, and importance in the diets of marine mammals, birds, and other fishes. It has been calculated to be the most important consumer of secondary production in the Alaskan Beaufort Sea and may influence the distribution and movements of marine mammals and seabirds (MMS, 1987: III-22).

Fourhorn sculpin are among the most widespread and numerous species along the Beaufort Sea coastline. This demersal fish is found in virtually all nearshore habitats including deeper waters not frequented by anadromous fishes. Saffron cod, arctic flounder, and starry flounder have similar distributions; however, their occurrence is sporadic and variable and in much lower numbers (MMS, 1987: III-22).

Canadian eelpout is a benthic fish species that is common on muddy bottoms. Twohorn sculpin, an offshore marine fish, is abundant but patchy in its distribution. Capelin is a widely distributed species that has been reported in areas west of the Mackenzie Delta; it usually is not abundant except in August when it spawns in coastal habitats (MMS, 1987: III-22).

Most marine species spawn during the winter period. Craig and Haldorson (1981) suggest that arctic cod spawn under the ice between November and February, and spawning areas appear to occur both in shallow coastal areas as well as in offshore waters. Fourhorn sculpin spawn on the bottom in nearshore habitats during midwinter. Snailfish are also winter spawners, attaching their adhesive eggs to rock or kelp substrate (MMS, 1987: III-22).

Feeding habits of marine species are similar to those of anadromous species in nearshore waters. Almost all of the marine species discussed rely heavily on epibenthic and planktonic crustacea such as amphipods, mysids, isopods, and copepods. Flounders also feed heavily on bivalve mollusks, while fourhorn sculpins supplement their diets with juvenile arctic cod (MMS, 1987: III-22).

## 2. Birds

Major concentrations of birds occur in and near the sale area (See Figures 3.2.A - C). The Colville River, Fish Creek, Sagavanirktok River, Kuparuk River, and Canning River deltas, and Simpson Lagoon, are very important nesting and breeding areas for waterfowl (MMS, 1996a: III-B-6). The Hulahula River, Colville River Delta, Simpson Lagoon, and Pitt Point are important molting and feeding areas during fall migration (ADNR, 1991:15). The Teshekpuk Lake Special Area (TLSA) portion of NPR-A is extremely important to waterbirds, as a nesting molting and staging area (Ott, 1998:2).

The Colville, Sagavanirktok and Kuparuk river deltas provide important breeding and brood-rearing habitats for tundra swans, black brant, snow geese, and Canada geese. Howe Island, located in the Sagavanirktok River delta, is the location of one of two known snow goose nesting colonies in the United States (Sousa, 1992). This island also is important for black brant nesting (Sousa, 1992:3). The Return Islands, Jones Islands, McClure Islands, Cross Island, and Lion Point are important for nesting common eider. Thousands of oldsquaws concentrate near Flaxman Island to molt (Bright, 1992). Greater-white fronted geese are also found nesting and rearing in the major river deltas and other coastal plain areas (Ott, 1997:2).

The most abundant marine and coastal species include: red phalarope, oldsquaw, glaucous gull, and common eider. Nearly all of these species are migratory and are found in the Arctic seasonally, generally from May through September. Shortly after spring migration, most shorebird and waterfowl populations disperse to nesting grounds primarily on tundra and marshlands of the Arctic Slope. Beginning in mid-July large

concentrations of oldsquaw and eider occur in coastal waters inshore of islands where the birds feed and molt before fall migration. Use of lagoons and other coastal habitats peaks in August to late September before and during the fall migration (MMS, 1996a:III-B-6).

The spring lead system east of Point Barrow provides a long but narrow front of open water which is utilized by millions of birds in their migration to nesting grounds. Nearly all of the king eider population of Alaska and Canada, as well as thousands of oldsquaws and common eiders, use this lead system (Sousa, 1991:2). Major concentrations of birds occur in nearshore and coastal areas such as the Plover Islands and Barrow Spit. They also concentrate at Pitt Point, and the Colville River delta. Timing of the spring migration varies with changes in wind direction and in the availability of open-water leads (USDOI, 1987:III-36).

Shortly after spring migration, shorebirds and waterfowl disburse to nesting grounds primarily on moist tundra and marshlands. Teshekpuk Lake, to the southeast of the sale area is a major nesting area. The Plover islands, such as Cooper and Deadman Islands, are important nesting grounds for black guillemont. The nearshore and coastal areas of Elson Lagoon in the Plover Islands also support thousands of marine birds. The same is true of the pelagic areas offshore Point Barrow (USDOI, 1987:III-36). Other species, such as common eider, glaucous gulls, black guillemots, and arctic turns, also nest on these barrier islands.

The Meade River Delta, about 90 miles southeast of Barrow, empties into Admiralty Bay. The Delta supports three species of loon; yellow-billed, arctic, red-throated loon. Nests and broods have been documented. Tundra swan broods and black brant and spectacled eider nests have been found within the Mead River area. White-fronted geese were found to use the Mead River when in molt, and migrating lesser snow geese were seen along the river in June (ADNR, 1992:19).

Oldsquaw is probably the most common species of waterfowl that nests in the Beaufort Sea area. They frequently nest in clusters or colonies. Their nests consist of small, cup-like hollows that are usually surrounded by tall grass. Oldsquaw clutches of 9 to 12 eggs are common, but most number 5 to 10 eggs. In the Beaufort Sea area most eggs hatch from July 16 to July 28. Female oldsquaws lead their young to the nearest water shortly after the young have hatchedand dried. Fall migration begins in late September or early October (Johnson and Herter, 1989:95).

The significant importance of barrier island shorelines, lagoons and nearshore areas to molting oldsquaw ducks has been well documented. Locations of major concentrations of molting oldsquaws including south shoreline and lagoons habitats near Thetis, Spy, Long, Jones, Arey, McClure, Pingok, Leavitt, Cottle, Egg, Pole, and Flaxman islands. Peak densities of oldsquaws molting in Simpson Lagoon were estimated at 50,000 birds, and approximately 32,000 oldsquaws have been recorded at a single time in the lagoon area behind Flaxman Island. The molt period extends from early June through early September (Sousa, 1998:5).

Although the population of oldsquaw ducks on the Arctic coastal plain of Alaska has remained relatively stable, populations in Northwest Canada and other regions in Alaska have declined 75 percent. This long-term decline in two out of three populations has prompted the U.S. Fish and Wildlife Service, migratory birds Management Division to review current management strategies and protection for this species (Sousa, 1998).

The Red Phalarope is a common migrant and breeder throughout the Beaufort Sea. They appear in the sale area in late May or early June. Nesting takes place in hummocky, moss seged-tundra interspersed with numerous ponds. Females usually lay four eggs, however if breeding is delayed, clutch size is reduced. Males incubate the eggs and care for the young until shortly before they are fledged. The fledging period is 16 to 18 days. The male then abandons the young and departs the breeding area. Adult migration commences from early June to mid-August. The young depart the nesting areas from mid-August to early September (Johnson and Herter, 1989:184).

The Glaucous Gull is a common migrant and breeder in the Beaufort Sea area. They usually arrive in the sale area during May. Glaucous Gulls select several types of nesting sites depending on availability. Pairs either nest on low islands and sandbars near or on the coast or on inland river bars or small islands in lakes.

They are most common on barrier islands immediately offshore from rivers that flood in the spring and thereby protect the nests from foxes. On level terrain, nests may be as much as a meter high and are composed of vegetation. Occasionally, nests consist of a simple depression in the beach and have little or no lining material. Egg laying begins in mid-June and continues through late June. The normal clutch size is 3 eggs and hatching begins in the second week of July. Chicks are attended by both parents until they fledge in about 45 to 50 days. During the breeding season these gulls prey heavily on the eggs and chicks of other birds. Fall migration begins in mid-September. The young remain somewhat later than most adults (Johnson and Herter, 1989:203).

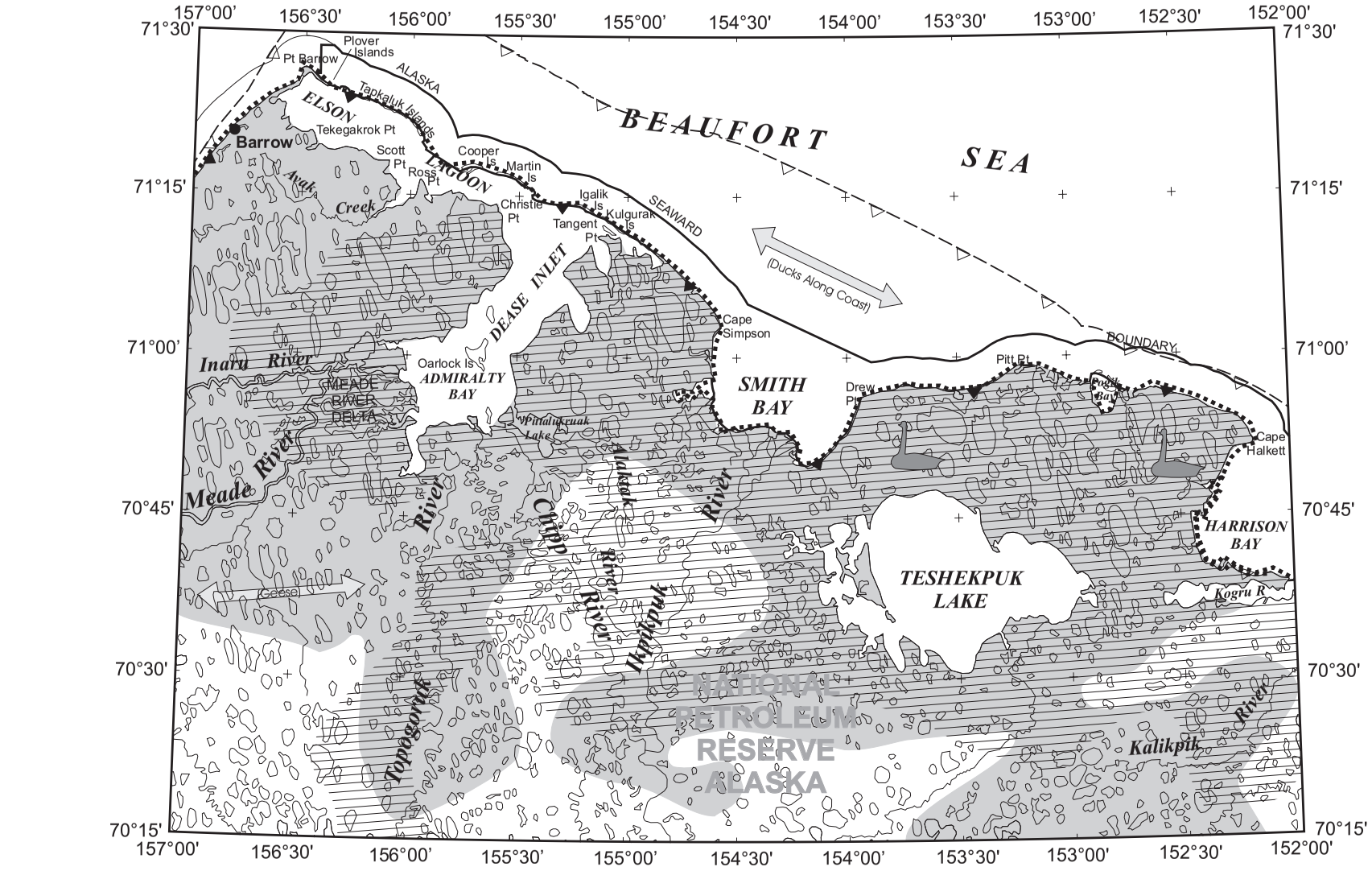
The Common Eider is an abundant species in the Beaufort Sea area. It is sometimes called the Pacific Eider and arrives in the sale area from late May to early June. They most commonly nest on barrier islands and spits from mid to late June. Clutch sizes range from one to ten eggs but usually number four. Nests are usually placed in well protected areas near logs, in driftwood, between rocks or in thick vegetation. Young are usually led directly to water soon after they hatch. Fledging occurs from 6 to 12.5 weeks after hatching. Males then leave their nesting areas for molting areas in the vicinities of Point Lay, Icy Cape, and Cape Lisburne in western Alaska. Females and their young begin the fall migration in late August or early September (Johnson and Herter, 1989:73).

Tundra swans are common breeders on the coastal plain of the North Slope. The Colville River Delta supports densities of breeding Tundra Swans that are three to five times greater than other arctic areas of Alaska. Several river deltas in ANWR also support relatively high numbers of nesting tundra swans. Swan concentration areas have been identified on the Canning, Hulahula, and Aichilak deltas, and at Pingokraluk Point and Demarcation Bay (ADNR, 1988:34).

Tundra Swans begin nesting during the last week of May and the first two weeks of June. Nests are large (approximately one meter high and up to two meter in diameter) and widely scattered. The nests are generally located on sedge tundra. After hatching in late June or early July, broods are reared in nesting territory (Smith et al., 1993:12). Adults molt from mid-July through August. Fall migration occurs from late September to early October. They winter along the east and west coasts of North America, from the Aleutian Islands to California and from Maryland to North Carolina (Johnson and Herter, 1989:17).

Black brant are a common migrant and breeding bird along the Beaufort Sea coast. Black brant nest on islands in the Colville River and the Sagavanirktok River deltas. Nesting takes place in June. Black brant normally lay 4 to 8 eggs. Black brant do not re-nest if their first attempt at nesting fails. The newly hatched geese leave the nest within 48 hours and they move to nearby tidal flats where they spend the brood-rearing period. Brood-rearing ends and the fall migration begins around the second week of August. Some brant remain in the Beaufort Sea area until late September or early October (Johnson and Herter, 1989:47).

Arctic peregrine falcons nest south of the sale area primarily on bluffs along the Colville River from Umiat to Ocean Point, and at Franklin and Sagwon Bluffs in the Sagavanirktok River drainage. Additional nest sites may occur at other locations. Arctic peregrine falcons are present on the North Slope from late April through September. Nesting begins by mid May, and the young birds fledge from late July to late August. Immature peregrine falcons from the Colville to the Sagavanirktok River drainages move toward the Beaufort Sea coast in mid to late August. Peregrine falcons generally have left the North Slope by late September (Ott, 1997).




## Important Bird Habitat

Source: ADF&G, 1984; 1986. MMS, 1997.

ADNR 5/7/99

**FIGURE 3.2.A**

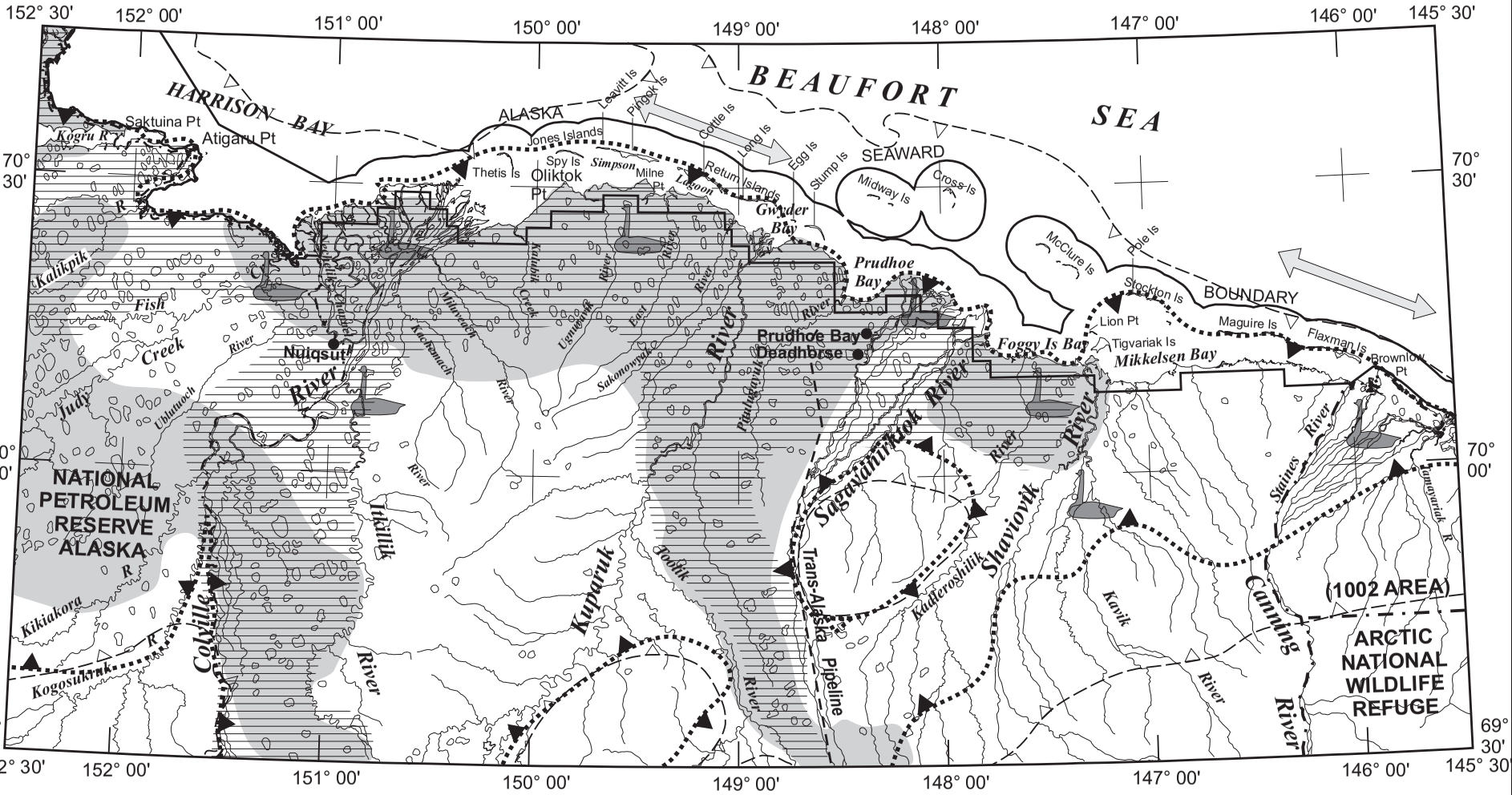



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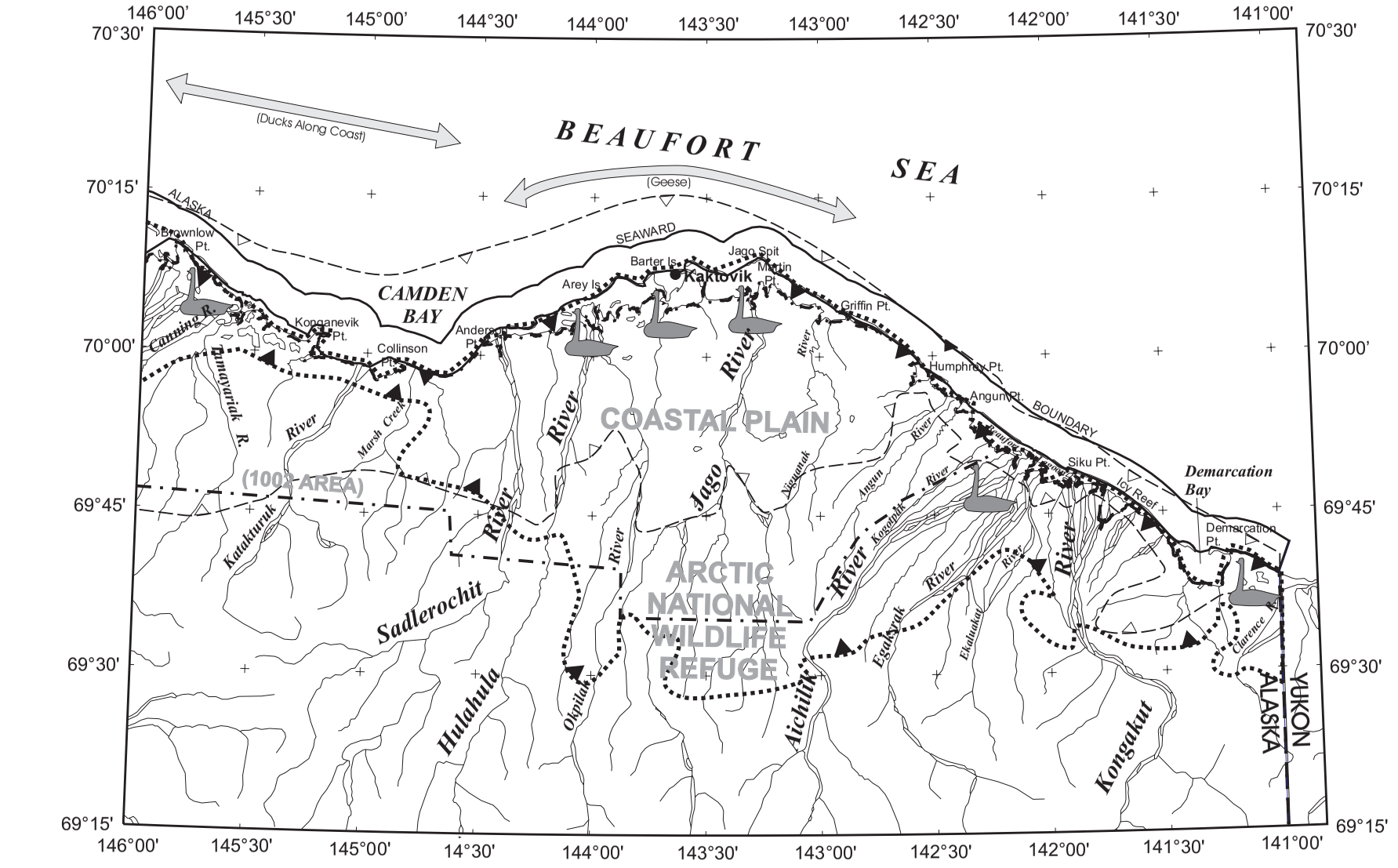
**FIGURE 3.2.B**




## Important Bird Habitat

Ducks — General Distribution

Geese — General Distribution

Tundra Swan — Known Nesting Concentration Areas

Known Migration Patterns (Ducks & Geese)

Sale Area

MAP AREA

Source: ADF&G, 1984;1986. USFWS 1987.

SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.

20 MILES 0 20 40 MILES

ADNR 5/7/99

**FIGURE 3.2.C**

## TABLE 3.4: Birds Commonly Observed in the Vicinity of Sale Area.

| Common Name | Scientific Name |
|---|---|
| Common Loon | *Gavia immer* |
| Red-throated Loon | *Gavia stellata* |
| Pacific Loon | *Gavia pacifica* |
| Yellow-billed Loon | *Gavia adamsii* |
| Red-necked Grebe | *Podiceps grisegena* |
| Tundra Swan | *Cygnus columbianus* |
| Brant | *Branta bernicla nigricans* |
| Greater White-fronted Goose | *Anser albifrons* |
| Snow Goose | *Chen caerulescens* |
| Canada Goose | *Branta canadensis* |
| Green-winged Teal | *Anas crecca* |
| Mallard | *Anas platyrhynchos* |
| Northern Pintail | *Anas acuta* |
| Northern Shoveler | *Anas clypeata* |
| American Wigeon | *Anas americana* |
| Greater Scaup | *Aythya marila* |
| Common Eider | *Somateria mollissima* |
| King Eider | *Somateria spectabilis* |
| Spectacled Eider | *Somateria fischeri* |
| Steller's Eider | *Polysticta stelleri* |
| Oldsquaw | *Clangula hyemalis* |
| Black Scoter | *Melanitta nigra* |
| Surf Scoter | *Melanitta perspicillata* |
| White-winged Scoter | *Melanitta fusca* |
| Red-breasted Merganser | *Mergus serrator* |
| Northern Harrier | *Circus cyaneus* |
| Rough-legged Hawk | *Buteo lagopus* |
| Golden Eagle | *Aquila chrysaetos* |
| Peregrine Falcon | *Falco peregrinus* |
| Gyrfalcon | *Falco rusticolus* |
| Willow Ptarmigan | *Lagopus lagopus* |
| Rock Ptarmigan | *Lagopus mutus* |
| Sandhill Crane | *Grus canadensis* |
| Black-bellied Plover | *Pluvialis squatarola* |
| American Golden-Plover | *Pluvialis dominica* |
| Semipalmated Plover | *Charadrius semipalmatus* |
| Whimbrel | *Numenius phaeopus* |
| Hudsonian Godwit | *Limosa haemastica* |
| Bar-tailed Godwit | *Limosa lapponica* |
| Ruddy Turnstone | *Arenaria interpres* |
| Red Knot | *Calidris canutus* |
| Sanderling | *Calidris alba* |
| Semipalmated Sandpiper | *Calidris pusilla* |
| Western Sandpiper | *Calidris mauri* |
| White-rumped Sandpiper | *Calidris fuscicollis* |
| Baird's Sandpiper | *Calidris bairdii* |
| Pectoral Sandpiper | *Calidris melanotos* |
| Dunlin | *Calidris alpina* |
| Stilt Sandpiper | *Calidris himantopus* |
| Buff-breasted Sandpiper | *Tryngites subruficollis* |
| Long-billed Dowitcher | *Limnodromus scolopaceus* |

| Common Name | Scientific Name |
|---|---|
| Common Snipe | *Gallinago gallinago* |
| Red-necked Phalarope | *Phalaropus lobatus* |
| Red Phalarope | *Phalaropus fulicaria* |
| Pomarine Jaeger | *Stercorarius pomarinus* |
| Parasitic Jaeger | *Stercorarius parasiticus* |
| Long-tailed Jaeger | *Stercorarius longicaudus* |
| Mew Gull | *Larus canus* |
| Herring/Thayer's Gull | *Larus argentatus/thayeri* |
| Glaucous Gull | *Larus hyperboreus* |
| Black-legged Kittiwake | *Rissa tridactyla* |
| Sabine's Gull | *Xema sabini* |
| Arctic Tern | *Sterna paradisaea* |
| Black Guillemot | *Cepphus grylle* |
| Snowy Owl | *Nyctea scandiaca* |
| Short-eared Owl | *Asio flammeus* |
| Horned Lark | *Eremophila alpestris* |
| Cliff Swallow | *Hirundo pyrrhonota* |
| Common Raven | *Corvus corax* |
| Gray-cheeked Thrush | *Catharus minimus* |
| Varied Thrush | *Ixoreus naevius* |
| Yellow Wagtail | *Motacilla flava* |
| Water Pipit | *Anthus spinoletta* |
| Orange-crowned Warbler | *Vermivora celata* |
| Yellow Warbler | *Dendroica petechia* |
| American Tree Sparrow | *Spizella arborea* |
| Savannah Sparrow | *Passerculus sandwichensis* |
| White-crowned Sparrow | *Zonotrichia leucophrys* |
| Dark-eyed Junco | *Junco hyemalis* |
| Lapland Longspur | *Calcarius lapponicus* |
| Snow Bunting | *Plectrophenax nivalis* |
| Rusty Blackbird | *Euphagus carolinus* |
| Robin | *Turdus migratorius* |
| Northern shrike | *Lanius excubitor* |
| Wheatear | *Oenanthe oenanthe* |
| Bluethroat | *Luscinia avacica* |
| Arctic warbler | *Phyiloscopus borealis* |
| Wilson's warbler | *Wilsonia pusilla* |
| Fox sparrow | *Passereila iliaca* |
| Common/Hoary Redpoll | *Carduelis flammea/hornemanni* |

Source: Adapted from ADNR 1991 and Martin 1996.

Snow geese arrive in the Sagavanirktok River delta during the last week of May and occupy nesting habitat on Howe Island in the first days of June. Most adult females arriving on the breeding grounds have already paired and copulated and have well-developed eggs in their oviducts. They lay their eggs within 4 days to a week after they arrive. They build their nests of grass and bits of willow on high ground. Clutch size is 3 to 6 eggs, which usually hatch during the last week of June or the first week of July. Snow goose goslings require about 7 weeks to fledge. They leave the brood-rearing areas by approximately August 15 to August 20 and congregate in immense flocks on the coastal tundra to feed almost continuously. Snow geese and black brant from the Howe Island colonies often move to the Kadleroshilik River delta to rear in the salt marshes (Ott, 1992). Half of the snow geese from the Howe Island colony take their broods to the Kadleroshilik River salt marshes for the months of July and August (Sousa, 1992:3). Fall migration begins in the second or third week of September (Johnson and Herter, 1989:29).

Spectacled Eiders were listed as threatened species under the Endangered Species Act on May 10, 1993. The primary reasons for listing spectacle eiders were their rapid and continuing decline on the Yukon-

Kuskokwim Delta (YKD) breeding ground and potential declines on the Alaskan Arctic coastal plain. Although the primary nesting area for spectacled eiders is the YKD, a minimum of 7,000 to 9,000 breeding spectacle Eiders occur on the Arctic coastal plain from Cape Simpson to the Sagavanirktok River. Breeding spectacled eiders use extensive wetlands such as large river deltas, tundra, and wet-polygonized coastal plains with numerous waterbodies. Females with broods use shallow ponds in lakes with emergent vegetation. Post-breeding male spectacled eiders depart the Arctic Coastal Plain wetlands approximately June 22 (plus or minus 11 days) and migrate offshore to a median distance of 6.7, km. Females lay one egg per day and begin incubation with the laying of the last egg. Clutch sizes average 4 eggs. Hatching occurs from mid-to late July. Fledging occurs approximately 50 days after hatching. Females and their broods then move directly from freshwater to marine habitats (USF&WS, 1996:20).

Post breeding female spectacled eiders depart the Arctic coastal plain brood-rearing sites approximately August 29 (plus or minus 10.5 days) and stage/migrate 16.6 km offshore. Because post breeding females are in poor physiological condition, harassment during feeding and staging in these areas may affect gain of lipid reserves required during migration and may ultimately impact survival. If present, male and female spectacled eiders may be impaired by potential exploration and development; and onshore, nearshore, and offshore environments (Sousa, 1998:5).

The Service published a final rule listing the Alaska breeding population of Steller's Eiders as threatened species on June 11, 1997. Steller's eiders migrate in the spring and fall over the Bering, Chukchi, and Beaufort seas following the coastline or barrier islands to their breeding grounds. From mid-May through mid-September, less than 1,000 pairs of Steller's Eiders breed across the Arctic Coastal Plain as far east as Prudhoe Bay; however, the only remaining area where breeding occurs regularly is Barrow, Alaska. Post breeding and young-of-the-year Steller's eiders may use coastal habitats in the Chukchi in Beaufort Sea to feed and stage prior to their return migration to the Bering Sea (Sousa, 1998).

Canada Geese arrive along the Arctic coast during the last two weeks of May and the first week of June. They nest primarily away from the sea coast, on bluffs along the Colville River. However, some isolated pairs have been found nesting in moderate densities in coastal wetlands near Prudhoe Bay. They usually lay their eggs during the first or second week of June. The clutch size may vary from 1 to 10 eggs which hatch within the first two weeks of July. After the goslings have fledged in mid-August, flocks begin dispersing along the Beaufort Sea and begin their southward migration.

The Greater white-fronted goose is a common breeding bird along the Beaufort Sea coast. They reach the Beaufort Sea breeding areas from the second week of May to the first week of June. The female usually selects a nest site on well-vegetated (scrub willow tundra) and well-elevated habitat near a lake or river. Eggs are laid during the last half of May or the first two weeks of June. The female lays her eggs in a slight depression and builds the nest as she completes her clutch of 4 to 7 eggs. The incubation period varies from 23 to 28 days. Breeding adults usually molt when goslings are 2 to 3 weeks old. Fall migration may begin as early as August 10 with the last Greater White-fronted Geese leaving Alaska by the end of September (Johnson and Herter, 1989:23).

The Colville River Delta supports some of the highest densities of breeding Yellow-billed loons in Alaska (Smith et al 1993:i). Yellow-billed loons arrive in the sale area in late May. They concentrate during spring with other species of loons in early-melting areas off the deltas of the Sagavanirktok, Kuparuk, and Colville Rivers. Yellow-billed loons prefer gently sloping shores of deep tundra lakes as nest sites. The nest is usually a built-up mound of turf and mud on the shoreline of a lake or occasionally on the shoreline of a large river. Egg laying begins as early as the second week of June and hatching takes place in July and early August. The normal clutch size is two eggs. The age at which Yellow-billed loons fledge has not been recorded precisely but may be similar to Common Loon chicks which is 45 days. The peak fall migration for yellow-billed loons is in late August or early September (Sousa, 1995:2; Johnson and Herter, 1989:9).

All eight wetland classification types developed by Bergman et al. occur within the uplands adjacent to the sale area. Four wetland types are generally used by birds more than others: Shallow-Arctophilia (Class III), Deep-Arctophilia (Class IV), basin-complexes (Class VI) and coastal (Class VIII) (Ott, 1977). In a study at Storkersen Point near the mouth of the Kuparuk River, Bergman et al. (1977) reported that these four

wetland types represented 35 percent of the area's wetlands, but received more than 68 percent of the study area's use by loons and other waterfowl. These wetlands support significant numbers of waterbirds, such as geese, ducks, and loons, and are used more intensively than other wetland types. Although limited in aerial extent, these wetlands are used more extensively by waterbirds than other wetland types.[1]

Class I—Flooded Tundra are shallow waters formed during spring thaw when melt water overflows stream basins or is trapped in vegetated tundra depressions. Such pools formed in low centers of polygonal ground often produce a mosaic pattern of ridges and flooded sedge.

Class II—Shallow-Carex are shallow ponds with a gently sloping shore zone surrounded by and usually containing emergent Carex aquatilis with a central open water zone.

Class III—Shallow-Arctophilia wetlands are shallow ponds or pools which contain pendent grass (*Arctophilia*) in the center and shoreward stands of pendent grass or sedge (*Carex*). Shallow water and extensive stands of pendent grass provide feeding and nesting habitat and cover for birds. Most species use these wetlands, but key species include red-throated loons, king eider, tundra swans, and pintails.

Class IV—Deep Arctophilia wetlands are second generation basins resulting from melting of ice-rich zones in drained basins. Identified by shoreward stands of pendent grass (*Arctophilia*) and a lack of emergent vegetation in their center, these ponds or lakes have distinct shores and flat or gently rolling bottoms. These lakes are principal aquatic habitats for all waterfowl, especially tundra swan, king and spectacled eider, oldsquaw, brant, and pacific and red-throated loons.

Class V—Class V: Deep-open.—Large, deep lakes that have abrupt shores, sublittoral shelves, and a deep central zone.

Class VI—Basin-complex wetlands are large and partially drained basins; they may contain water continuously in the spring, but as summer progresses, water levels recede. Since water levels vary, vegetation is diverse and prolific. Non-breeding pintails feed in these basins, and emergent vegetation stands provide cover during their wing molt in July. King eiders and loons use lakes within basin-complexes for feeding and staging, principally during the early summer before deeper wetlands have thawed.

Class VII—Beaded Stream wetlands are small, often intermittent, streams consisting of a series of channels formed in ice-wedges and linked to pools that develop at ice-wedge intersections. Beaded Streams are common throughout the coastal plain, and they are often the only class of wetlands in large areas of well drained regions of the interior coastal plain.

Class VIII—Coastal Wetlands are aquatic habitats bordering the Beaufort Sea within a zone directly influenced by seawater. Periodic saltwater flooding, the presence of brackish water, and unique vegetation of sedge and grass distinguish coastal wetlands from other types. Nesting and feeding black brant use coastal wetlands. Coastal wetlands are primarily used by snow geese for brood-rearing and staging. These wetlands may be found in most river deltas and adjacent to coastal lagoons.

# 3. Terrestrial Mammals

## a. Caribou

Caribou (*Rangifer tarandus*) are members of the deer family. Four caribou herds use the coastal habitats adjacent to the sale area (See Figure 3.3.A - C). A herd is a group of caribou that establishes a calving area distinct from any other group and calves there repeatedly (ADF&G, 1994). The Western Arctic Herd (WAH) ranges over an area that extends approximately from the Colville River to the western coast of Alaska

[1] Lessees are advised that the state may adopt, or approve the use of, an alternate wetlands classification system in the future. However, the protective nature of the wetlands mitigation measures developed for this and other oil and gas lease sales will remain consistent regardless of the wetlands classification system ultimately selected.

and north from the Kobuk River to the Beaufort Sea. In winter the range extends as far south as the Seward Peninsula and Nulato Hills and as far east as the Sagavanirktok River north of the Brooks Range, and east of the Koyukuk River south of the Brooks Range. The WAH's major calving area is inland on the NPR-A (USDOI, 1997:III-B-39).

The Teshekpuk Lake Herd (TLH) occupies the area around Teshekpuk Lake. Its summer range extends between Barrow and the Colville River. In some years, most of the TLH remains in the Teshekpuk Lake area all winter. In other years, some or all of the herd winters in the Brooks Range or within the Western Arctic Herd (WAH) range(USDOI, 1997:III-B-39). TLH caribou have been observed in the Colville River Delta seeking relief from insect harassment (Smith et al, 1993:46). Calving is generally located on the east side of Teshekpuk Lake and near Cape Halkett adjacent to Harrison Bay (USDOI, 1997:III-B-39).

The range of the Central Arctic Herd (CAH) extends from the northern foothills of the Brooks Range to the Beaufort Sea and from the Colville River east to the Canning River. The CAH calving area has been described as the area between the Eastern Channel of the Colville River and Kalubuk Creek (Smith et al., 1994, 9; citing to Lawhead and Cameron, 1988). Current primary calving concentration areas lie between the Sagavanirktok and Canning Rivers in the area south of Bullen Point, and to the southwest of the Kuparuk oilfield (Ott, 1997). Lesser used calving areas have also been identified between the Eastern Channel and the Nechelik Channel of the Colville (Smith, et al. 1994, 9; citing to Whitten and Cameron, 1985) and in the foothills of the Brooks Range, south of the Colville River delta.

The Porcupine Caribou Herd (PCH) ranges south from the Beaufort Sea coast, from the Canning River eastward through the northern Yukon and portions of the Northwest Territories in Canada, and south to the Brooks range (MMS, 1998a). During early, mid-and late winter the range in Alaska is centered in the Chandalar River Arctic Village area and use appears correlated with normal to deep snow. Calving follows the coastal plain from the Hulahula River into Canada. Areas of concentrated use are centered in the Jago Uplands and extend between the Hulahula and the Aichilik Rivers in Alaska (IPCB, 1993:10). Spring migrations of the PCH to calving grounds on the coastal plain generally start in April-May from winter ranges, which are usually south of the Brooks Range in Alaska and in the central Yukon Territory and adjacent Northwest Territories in Canada. Timing and routes of PCH migrations vary annually depending on the winter distributions of the herd and snow conditions in ANWR. Most PCH caribou migrate from Canada, moving westward along the northern foothills of the Brooks Range to reach their calving grounds. In some years, caribou also pass through the first snow-free mountain valleys east of the Aichilik River in Alaska. As spring progresses, caribou in the foothills spread northward along a broad front, mostly following the major river corridors and associated terraces where snowmelt has advanced.

In late May or early June a single calf is born (twins are very rare), mostly within 30 miles of the coast. Coastal areas seem to be preferred calving habitats, but calving occurs further inland as well (Baker 1987:1-3). Newborn calves can walk within an hour of birth. After a few days, they can outrun a man and swim across lakes and rivers. Newborn calves weigh an average of 13 pounds and may double their weight in 10 to 15 days (ADF&G, 1994). Use of calving habitat varies with weather and snow conditions. The fidelity of caribou to their calving area suggests that certain areas, such as those mentioned above may be more important than other seasonal ranges.

In midsummer, from mid-to-late June through July, caribou are often harassed by hordes of mosquitoes, warble flies, and nose flies. In Alaska, the coastal plain adjacent to the Beaufort Sea offers primary insect relief for the female segment of the herd (IPCB, 1993:19). Movement during the summer is closely tied to insect harassment. In response, caribou move from inland feeding areas to windswept, vegetation-free coastal areas where the insects are limited. Sometimes the animals will run in a frenzy for long distances, stopping to rest only when exhausted or when wind offers relief from the insects (ADF&G, 1994). Caribou use the coastline extensively and river deltas are used more than other sections of the coast. Caribou have occasionally been reported on barrier islands such as Tigvariak, and Cross Island at all times of the year. They probably wade, swim (rarely) and walk over ice. While caribou use the barrier islands, the islands aren't considered critical or even important habitat. Caribou usually stay on the beach and not in the water. However, they do occasionally stand in water when insects are particularly bad (Whitten, 1999). Most insect relief areas are found within two miles of the coast (ADF&G 1985a:71), however, caribou also tend to

congregate on gravel drilling pads and roads which are generally raised above the tundra and more exposed to the elements (USACE 1984:141). Caribou that remain inland may move to river bars and bluffs to escape these insects. The frequency and duration of caribou movements to and from the coast depend on weather related changes that affect the number of mosquitoes. Caribou distribution on the coastal plain can change dramatically within a 24-hour period.

The fall migration south begins in September and ends by mid-November. During both the spring and fall migrations, the herd tends to move along or near major river drainage. Caribou generally winter in the northern foothills of the Brooks Range. Occasionally, some remain on the coastal plain during mild winters. (Ott, 1992).

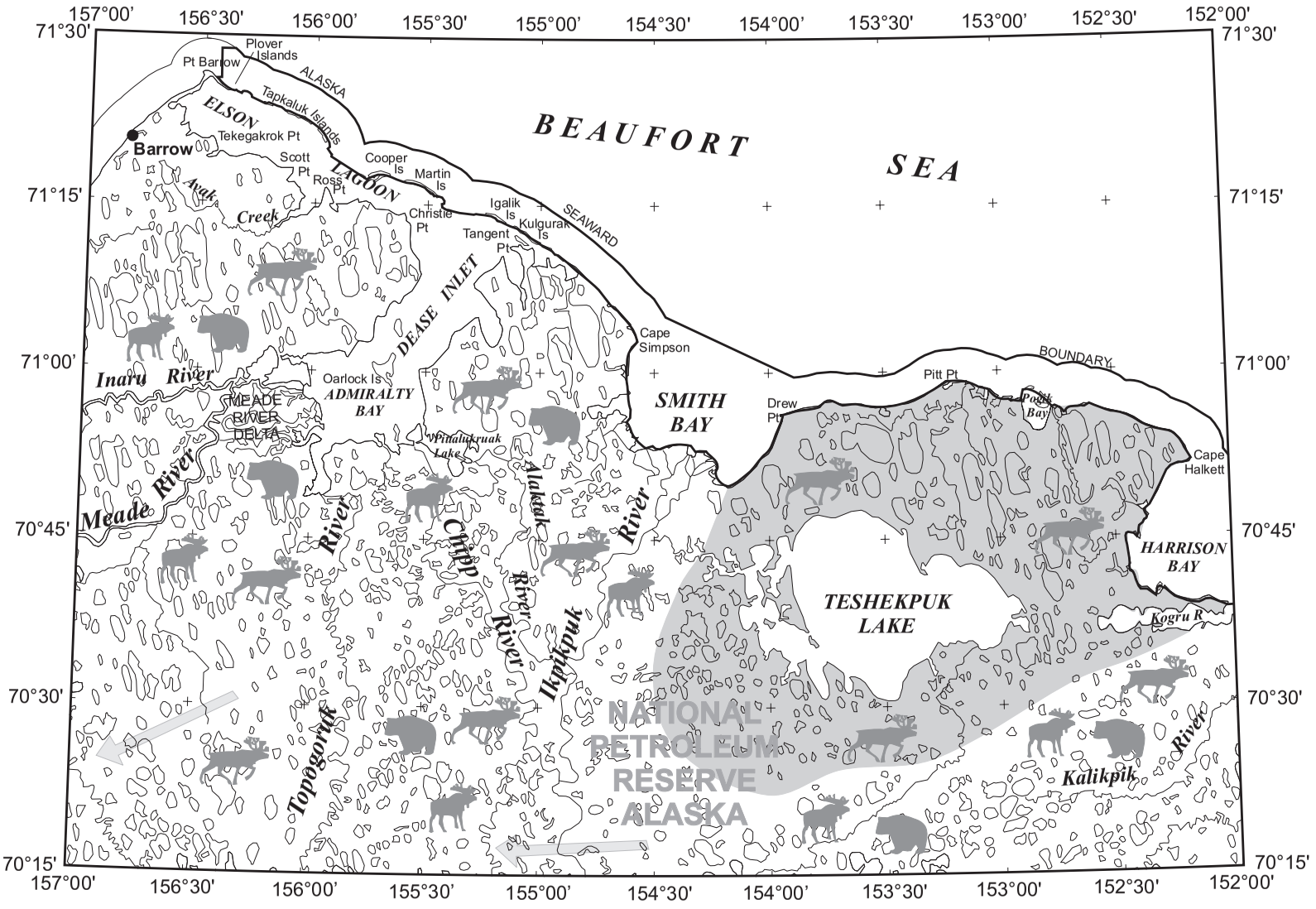
In early July the PCH usually moves east and south, vacating the coastal plain area by mid-July. In some years, residual groups numbering as many as 15,000 animals have remained in the coastal plain area and adjacent foothills and mountains throughout August. The actual fall migration south to winter ranges usually begins in September and ends by mid-November. The PCH generally utilizes two principal wintering areas: the central portion of the Yukon Territory and the area in the vicinity of Arctic Village in Alaska. Some animals occasionally winter on the Arctic slope. (ADF&G, 1986a:51)

Caribou must keep moving to find adequate food. This distributes feeding pressure and tends to prevent overgrazing. Caribou are great wanderers and very efficient at moving across both boggy and rugged terrain. They commonly travel vast distances to reach suitable foraging sites on widely separated season ranges. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases. In summer, caribou eat a wide variety of plants, apparently favoring the leaves of willows, grasses, and herbaceous and flowering plants. During winter, they use windswept upland areas, or areas of lighter snow cover where they can dig through the snow to feed on lichens, "reindeer moss," and dried sedges (ADF&G, 1994).

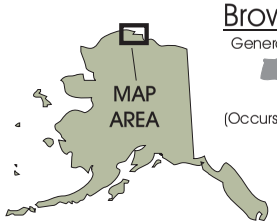
Historic population counts for all four herd populations are depicted in Table 3.5. Caribou calf survival and adult mortality are primary factors affecting the size and growth of caribou herds. The WAH population grew to about 450,000 by 1993, primarily because calf survival far exceeded adult mortality until the early 1990s. However, biologists note that the WAH calf survival rate is in decline, and adult deaths per 100 animals are increasing; a trend which may result in herd size reduction if it persists. Neither hunting pressure, disease, nor predation by wolves or bears appear to be a factor in the calf survival or adult mortality trend (Cronin, et al., 1994)(ADF&G, Undated).

ADF&G's 1995 photo-census revealed less caribou in the CAH than in previous census years. The current decline is likely due to a reduction in calf production; a factor biologists correlate with lower nutritional condition of cows at the end of the summer grazing season. While this lack of nutrition may be linked to summer forage availability, other factors may explain the decline in herd size. "After its rapid increase through the 1980s, the CAH may have reached carrying capacity. This could have resulted in population stability. Or, if the population temporarily exceeded carrying capacity, there could have been overgrazing leading to a population decline." (Whitten, 1995:2)

Indications that a herd may overgraze its range and "crash" include smaller calf weight and lower calf production. The Nelchina herd, located outside of the sale area experienced a dramatic decline in population (70,000 animals to less than 10,000) from 1960 to the early 1970's (ADN, 1996).




## Important Wildlife Habitat




**Brown Bear**
General Distribution
(Occurs Region-Wide)

**Caribou**
General Distribution
(Throughout Area, Spring & Fall)
Caribou Calving Area (TLH)
Known Migration Patterns (Caribou)

**Moose**
General Distribution
(Throughout Area)

**Sale Area**

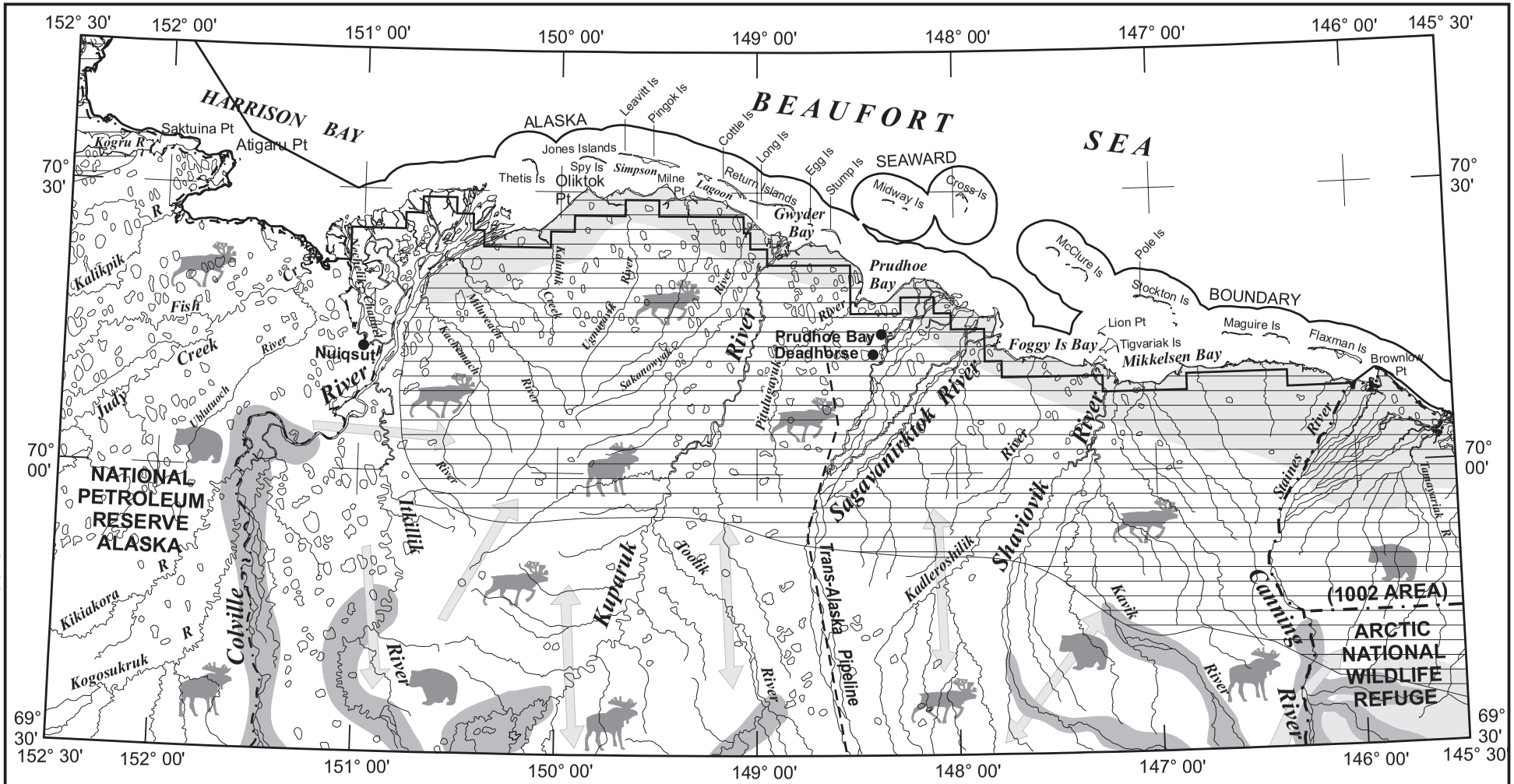
Source: ADNR, 1993, 1996. ADF&G, 1986.

SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.

20 MILES 0 20 40 MILES

ADNR 5/7/99

**FIGURE 3.3.A**






## Important Wildlife Habitat

**Brown Bear**
General Distribution
(Occurs Region-Wide)

**Sale Area**

**Caribou**
General Distribution
(Throughout Area, Spring & Fall)
Caribou Insect Relief
Caribou Calving Area
Known Migration Patterns (Caribou)

**Moose**
General Distribution
(Throughout Area)
Known Winter Concentration Areas

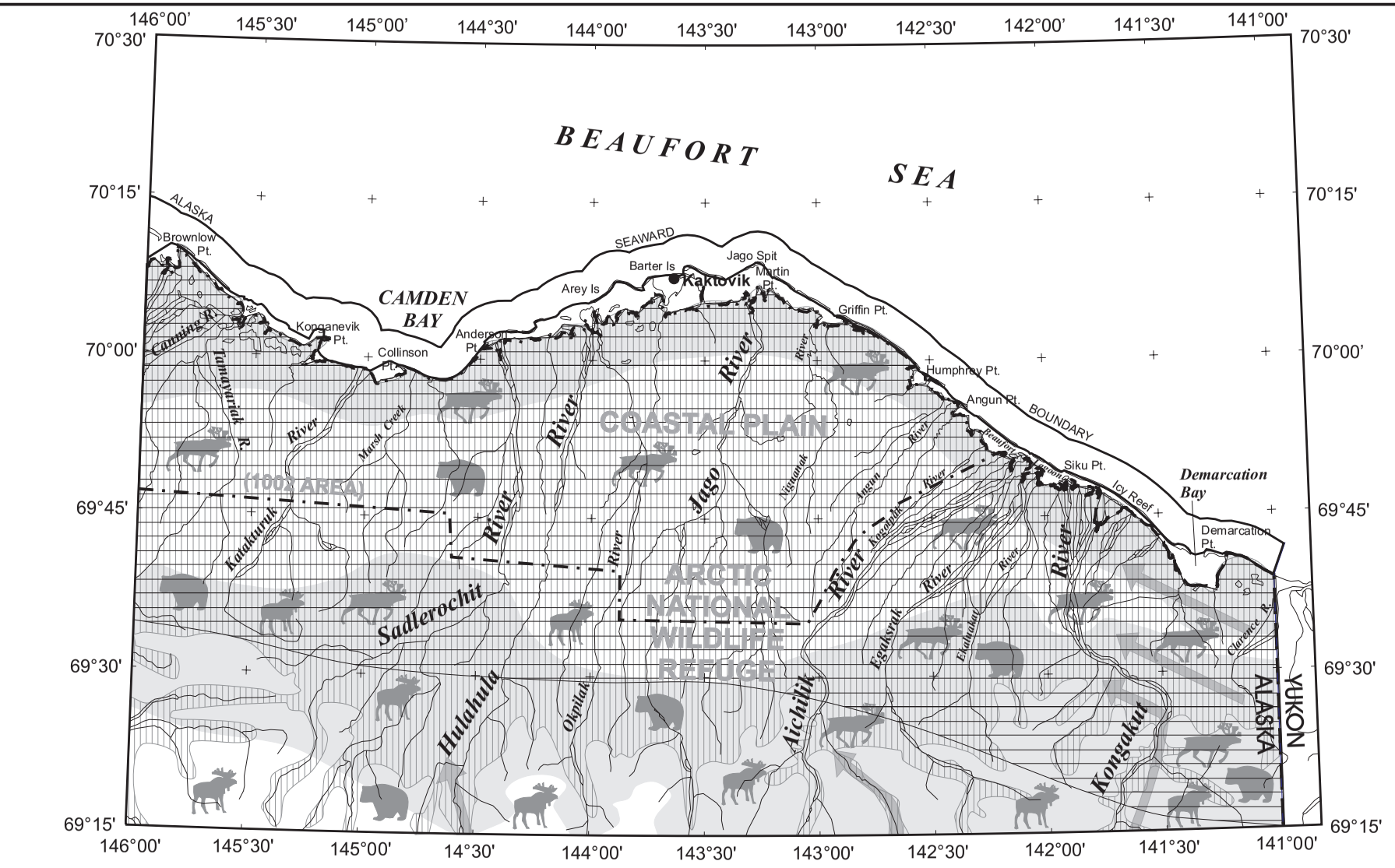
MAP AREA

Source: ADNR, 1993, 1996. ADF&G, 1986.

SCALE 1:1,100,000 ONE INCH = 18 MILES APPROX.
20 MILES 0 20 40 MILES

ADNR 5/7/99

**FIGURE 3.3.B**




## Important Wildlife Habitat

**Brown Bear**
General Distribution
(Occurs Region-Wide)

**Caribou**
General Distribution
(Throughout Area, Spring & Fall)
Caribou Calving Area
Caribou Insect Relief
Known Migration Patterns (Caribou)

**Moose**
General Distribution
(Throughout Area)
Known Winter Concentration Areas

Sale Area

MAP AREA

SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.

20 MILES 0 20 40 MILES

Source: ADNR, 1993, 1996.
ADF&G, 1986.

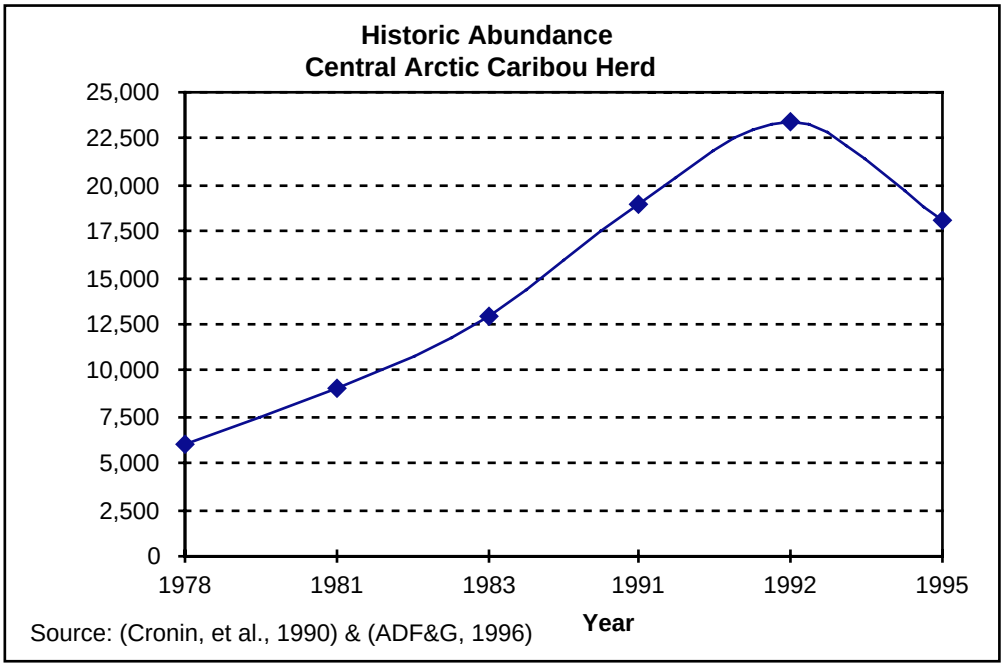
ADNR 5/7/99

**FIGURE 3.3.C**

**Table 3.5 Historic Population Counts for Caribou Herds.**

| Western Arctic Herd | | Central Arctic Herd | | Teshekpuk Caribou Herd | | Porcupine Caribou Herd | |
|---|---|---|---|---|---|---|---|
| Year | Number of Animals | Year | Number of animals | Year | Number of Animals | Year | Number of Animals |
| 1976 | 75,000 | 1978 | 6,000 | 1982 | 4,000 | 1972 | 100,000 |
| 1978 | 102,000 | 1981 | 9,000 | 1989 | 16,700 | 1977 | 105,000 |
| 1980 | 138,000 | 1983 | 12,900 | 1993 | 27,600 | 1982 | 125,200 |
| 1982 | 171,700 | 1991 | 18,900 | 1995 | 26,000 | 1983 | 135,300 |
| 1986 | 229,400 | 1992 | 23,400 | | | 1987 | 165,000 |
| 1988 | 343,200 | 1995 | 18,093 | | | 1989 | 178,000 |
| 1991 | 415,700 | | | | | 1992 | 163,500 |
| 1993 | 450,000 | | | | | 1994 | 152,000 |

Source: Cronin, et al., 1994; ADF&G, Undated; Whitten, 1995




## b. Moose

Moose are the world's largest members of the deer family, and the Alaska moose *(Alces alces gigas)* is the largest of all the moose. Moose breed annually and both sexes may begin breeding at an age of 16 to 18 months. Calves are born any time from mid-May to early June after a gestation period of about 230 days. Calves begin taking solid food a few days after birth. Newborn calves weigh 28 to 35 pounds and within five months grow to over 300 pounds (ADF&G, 1994).

Rutting occurs during the fall between late September and early October. During this period, moose may aggregate in groups of up to 30 bulls and cows, with movement of individuals between the groups (ADF&G 1985a:139-146).

Moose eat a variety of foods, particularly sedges, equisetum (horsetail), pond weeds, and grasses. During summer, moose feed on vegetation in shallow ponds, forbs, and the leaves of birch, willow, and aspen. Willow stands along rivers and streams are important winter habitat for moose. These riparian areas are especially important during the winter when forage is mainly confined to willow stands along major drainages where shrubs will not be covered by drifting snow (Sousa, 1992).

Following the snow melt, usually around the beginning of May, moose occasionally disperse across the tundra, but are mainly found in varying elevations in the foothills (See Figures 3.3.A - C). Calving also occurs at this time. Moose feed on aquatic vegetation, grasses, sedges, and willow during spring and summer. During winter they feed on deciduous shrubs and crater in the snow for ferns, willow, and foliose lichen.

Moose have a high reproductive potential and can quickly fill a range to capacity if not limited by predation, hunting, and severe weather. Deep crusted snow can lead to malnutrition and subsequent death of hundreds of moose and decrease the survival of the succeeding year's calves. Predation by wolves and bear limits the growth of moose populations in Alaska (ADF&G, 1994).

Moose occur all across the North Slope, but this has not always been the case. Fifty years ago there were few moose on the lower Colville River. Breeding populations migrated north and became established. Surveys in the last 26 years show a population increase from 1,200 to 1,600 moose in that time. Today, the North Slope moose population is experiencing an alarming decline. The adult population has declined by 50 percent in the last four to five years. There has been little if any calving success in the last three years, and biologists are not sure of the cause. It could be a combination of factors, such as food availability and habitat limitation (population beyond carrying capacity of the habitat), disease, nutrition, predation, toxicity, and mosquito harassment. Food supply varies from year to year, and forage is limited. Moose populations along the Colville and Kavik Rivers are at the northern extent of the species' range, and they are susceptible to bad winters. Increasing populations of wolf and bear is also a likely factor contributing to the decline (Carroll, 1996). A lack of forage could lead to a mineral deficiency which can result in increased predation. Toxicology analysis on the tissue of dead animals collected in the summer of 1996 are being analyzed (O'Hara, 1996).

## c. Brown Bears

Formerly, taxonomists listed brown and grizzly bears as separate species. Technically, brown and grizzly bears are classified as the same species, *Ursus arctos*. Generally the term brown bear is used for those found in coastal areas while bears found in the interior areas of Alaska are known as grizzlies (ADF&G, 1994).

Brown bears occur on barrier islands and nearshore areas of the sale area (Ott,1998:4). On the North Slope brown bear densities range up to six bears/ per100 sq. mi. The number of brown bears using the Prudhoe Bay and Kuparuk oilfields has increased in recent years, most likely due to the supplemental food supply (garbage) available there (Sousa, 1992:6). Twenty-seven bears were captured and marked by ADF&G in studies of bear use of the oilfields. These bears have very large home ranges (2,600 to 5,200 sq. km) and travel up to 50 km a day (USDOI, 1997:III-B-43). Brown bears travel along the major river corridors and feed extensively in riparian areas of the sale area in the spring and summer and often make their dens along river banks in the fall (See Figures 3.3.A - C). Bear weights vary depending on the time of year. Bears weigh the least in the spring or early summer. They gain weight rapidly during late summer and fall just prior to denning (ADF&G, 1994).

In the winter when food is unavailable or scarce, brown bears enter dens and hibernate through the winter. During hibernation, their body temperatures, heart rate, and other metabolic rates are reduced, and their need for food and water is eliminated. Bears may spend from 5 to 7-1/2 months in dens. Brown bears enter their dens from mid-October through November (Ott, 1997). On the coastal plain, bears den in low hills, dry lake margins, and stream banks to at least within 20 miles of the coast (Ott, 1991). Recent ADF&G grizzly bear research confirms some of the bears using the oilfields den within a mile of the coast (Ott, 1997). They normally leave their dens in April and early May; adult males emerge first, followed by single females, then sows with young (ADF&G, 1994).

Except for females with offspring and breeding animals, bears are typically solitary creatures and avoid the company of other bears. Exceptions to this occur where food sources are concentrated, such as streams, where bears can catch salmon swimming upstream to spawn (ADF&G, 1994). In the spring, brown bears are commonly found in major river valleys, such as the Colville and Itkillik. They later move to small tributaries and poorly drained areas to feed.

Mating takes place from May through July with the peak of activity in early June. Brown bears generally do not have strong mating ties. Individual bears are rarely seen with a mate for more than a week. Males may mate with more than one female during breeding season. The young are born the following January or February in a winter den. Litter size ranges from one to four cubs, but two is most common. Offspring typically separate from their mothers as two-year olds in May or June. In some areas where food is scarce, females may skip one to three years before producing new litters (ADF&G, 1994).

Brown bears consume a wide variety of foods such as berries, grasses, sedges, horsetails, cow parsnips, fish, ground squirrels, and roots of many kinds of plants. In some parts of Alaska, brown bears have been known to prey on newborn moose and caribou. They can also kill healthy adults of these species. Bears are fond of all types of carrion as well as garbage in human dumps. Brown bears have an especially good sense of smell and under the right conditions may be able to detect odors more than a mile distant (ADF&G, 1994). During the summer bears most frequently feed in wet sedge meadows, late snow bank areas, and tussock tundra, concentrating on grasses, sedges, the fruiting and vegetative stems of horsetails. In the fall, bears tend to use the floodplains of large creeks and rivers, dry ridge areas or mountain slopes and feed on roots, berries, and ground squirrels (ADF&G, 1985a:103-109).

## d. Muskoxen

The muskox (*Ovibos moschatus*) is a stocky, long-haired animal with cloven hooves, a slight shoulder hump and a very short tail. Taxonomists classify muskoxen with the sheep and goats. Muskoxen as a species have changed little since the ice age and are perfectly adapted to live in their harsh arctic environment (ADF&G, 1994).

The original Alaska muskoxen disappeared in the mid- or late-1800s as a result of over-hunting. Muskoxen were re-introduced in ANWR in 1969 and in the Kavik area in 1970; they were reintroduced near Cape Thompson in 1970 and 1977. An estimated 270 muskoxen were counted between the Colville River and ANWR, and 91 animals were recorded west of the TAPS near the Colville River (USDOI, 1997:III-B-42). Muskoxen are expected to repopulate their former home-range habitats in the NPR-A in the near future. Small numbers occur in the Colville River Delta, in the area of the lower Itkillik River valley, and the headwaters of the Miluveach and Kachemack Rivers (Ott, 1997). Known wintering areas occur along riverside bluffs in the vicinity of the Sagavanirktok and Ivishak rivers, and along the Kavik and Shaviovik river drainages near the coast. During summer they also utilize the Kadleroshilik drainage (Sousa, 1992).

The most important habitats for muskoxen in the Colville River Delta are riparian, upland shrub and moist sedge-shrub meadows (USDOI, 1997:III-B-42). Riparian habitat is preferred by muskoxen for virtually their entire annual cycle. River systems that provide diverse low shrub-forb and tall willow communities in proximity to relatively snow-free uplands, hillsides, and plateaus are also important habitat (Sousa, 1992).

Muskoxen are relatively sedentary in the winter (October-May), possibly as a strategy for conserving energy. Muskoxen are not migratory, but they may move in response to seasonal changes in snow cover, vegetation, and natural behavior. Many bull muskoxen move from mixed sex groups during the summer to bull groups during the winter. Females calve from late April to mid-June, and newborn calves have been observed in ANWR during mid-June (Garner and Reynolds, 1987). Limited data suggest that the majority of the population calves in the southern portion of the Arctic coastal plain on wind-blown, snow-free banks within riparian areas, and in upland sites in the foothills. The rutting season generally occurs in August (Reynolds, 1992).

Muskoxen eat a wide variety of plants, including grasses, sedges, forbs, and woody plants. In summer and fall, both sexes may be found along major river drainages where they feed on willows and forbs. In winter and spring, muskoxen groups of 10 to 20 animals may be found in the uplands adjacent to river drainages which afford forage of tussock sedges and have less snow cover (USDOI, 1987:27). Muskoxen are poorly adapted for digging through heavy snow for food, so winter habitat is generally restricted to areas with shallow snow accumulations or areas blown free of snow (ADF&G, 1994).

## e. Furbearers

Other species that may be found in the sale area include arctic and red fox, wolf, and wolverine. Information on the abundance and distribution of these species is limited.

Arctic Fox. *(Alopex lagopus)* Both blue and white color phases occur, with the white color phase more common in northern litters. Young of each color phase may occur in the same litter (ADF&G, 1994).

Arctic fox pups are born in dens excavated by the adults in sandy, well-drained soils of low mounds and river cut backs. Most dens have southerly exposure. They extend from 6 to 12 ft. underground. Enlarged ground squirrel burrows with several entrances are often used as dens (ADF&G, 1994).

Mating occurs in early March and early April. Gestation lasts 52 days. Litters average seven pups but may contain as many as 15 pups. Arctic foxes are monogamous in the wild. Both parents aid in bringing food to the den and in rearing the pups. Pups begin eating meat when about one month old and are fully weaned by 1-1/2 months. They emerge from the den when about three weeks old and begin to hunt and range away from the den at about three months. Arctic foxes attain sexual maturity at 9 to 10 months, but many die in their first year (ADF&G, 1994). Fully grown arctic foxes weigh from 6 to 10 pounds.

Arctic foxes are omnivorous. In summer, they feed primarily on small mammals, including lemmings and tundra voles. They sometimes eat berries, eggs, and scavenged remains of other animals. Many foxes venture out onto the sea ice during winter to eat the remains of seals killed by polar bears. In areas where lemmings and voles are the most important summer prey, numbers of foxes often rise and fall with cyclic changes of their prey. Fewer pups are successfully reared to maturity when food is scarce. There is evidence indicating that competition for food among young pups accounts for some of the heavy mortality in this age group (ADF&G, 1994). Arctic foxes may move long distances over sea ice. A fox tagged along the coast of Russia was captured near Wainwright, Alaska a year later (ADF&G, 1994).

Wolf. Wolves *(Canis lupus)* are adaptable and exist in a wide variety of habitats including the Arctic tundra along the Beaufort Sea. Wolves are members of the family Canidae. They are highly social animals and usually live in packs averaging 6 to 7 animals (ADF&G, 1994).

Wolves normally breed in February and March, and litters averaging about five pups are born in May or early June. Litters may include from 2 to 10 pups, but most often 4 to 7 pups are born. Most female wolves first breed when 22 months old but usually have fewer pups than older females. Pups are usually born in a den excavated as much as 10 ft. into well-drained soil, and most adult wolves center their activities around dens while traveling as far as 20 miles away in search of food, which is regularly brought back to the den. Wolf pups are weaned gradually during midsummer. In mid- or late summer, pups are usually moved some distance away from the den and by early winter are capable of traveling and hunting with adult pack members. Wolves are great travelers, and packs often travel 10 to 30 or more miles in a day during winter. Dispersing wolves have been known to move from 100 to 700 miles from their original range (ADF&G, 1994).

In spite of a generally high birth rate, wolves rarely become abundant because mortality is high. In much of Alaska, hunting and trapping are the major sources of mortality, although diseases, malnutrition, accidents, and particularly preying by other wolves act to regulate wolf numbers (ADF&G, 1994).

Wolves are carnivores, with moose and/or caribou as their primary food. During summer, small mammals including voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish are supplements in the diet. Wolves are opportunistic feeders; very young, old, or diseased animals are preyed upon more heavily than other age classes. Under some circumstances, however, such as when snow is unusually deep, even animals in their prime may be vulnerable to wolves (ADF&G, 1994).

Wolverine. The wolverine, is the largest terrestrial member of the family *Mustelidae*. Its scientific name is *Gulo gulo*, meaning glutton. Wolverines are primarily found in the wilder and more remote areas of Alaska(ADF&G, 1994). They frequent all types of terrain and often utilize rivers as territorial boundaries (USF&WS, 1987:339).

Wolverines become sexually mature in their second year. Breeding takes place between May and August. After wolverines mate, the embryo floats in the uterus until late fall or early winter. This type of reproduction is known as delayed implantation, and allows a female wolverine to become pregnant when food supplies are plentiful and when she is in good physical condition. The abundance of food determines whether a pregnancy will be maintained and the number of young that will be born (ADF&G, 1994).

Litters are born between January and April. In Interior and northern Alaska, most young are born in snow caves. These caves usually consist of one or two tunnels that can be up to 60 yards long. Litters usually number between one to three. Baby wolverines, called kits, develop rapidly and are weaned at about eight weeks of age. They leave their mothers at approximately 5 or 6 months to forage for themselves (ADF&G, 1994).

Wolverines travel extensively in search of food. They are opportunistic, eating about anything they can find or kill. They are poor hunters, but are well adapted for scavenging. Wolverines can survive for long periods on little food. Their diet varies from season to season depending on food availability. In the winter, wolverines rely primarily on remains of moose and caribou killed by wolves and hunters or animals that have died of natural causes. Throughout the year, wolverines feed on small and medium-sized animals such as voles, squirrels, snowshoe hares, and birds. In the right situations, wolverines can kill moose or caribou, but these occurrences are rare (ADF&G, 1994).

## 4. Marine Mammals

Marine mammals inhabiting the sale area include polar bear, bowhead whale, ringed seal, spotted seal, and bearded seal. Walrus occasionally are seen in the sale area. Beluga whales can be found to the north outside of the sale area but are rarely seen in state waters. The majority of the Beaufort Sea beluga whale stock occurs between 30 and 80 nautical miles from shore. No gray whales were sighted in the Beaufort Sea during the 1994-1996 surveys but have been seen near Barrow in previous years (Treacy, 1998).

### a. Polar Bears

Polar bears (*Ursus maritimus*) occur only in the northern hemisphere, nearly always in association with sea ice. Polar bears and brown bears evolved from a common ancestor and are still closely related, as demonstrated by mating and production of fertile offspring in zoos. Although polar bears may be similar in size to some southern coastal brown bears, polar bears are considerably larger than the brown bears found along the North Slope (Ott, 1997). Adaptations by the polar bear to life on sea ice include a white coat with water repellent guard hairs and dense underfur, short furred snout, short ears, teeth specialized for a carnivorous diet, and hair nearly completely covering the bottom of the feet (ADF&G, 1994).

The distribution of polar bears is strongly influenced by the local and annual patterns of ice formation, distribution, and thaw (See Figures 3.4.A - C). The reforming of the landfast ice sheet in late fall and early winter triggers male polar bears to move toward land from the permanent pack ice far offshore (MMS 93-0008:5). Seasonal movements are influenced primarily by the state of the sea ice and its effect on the distribution of prey. The distribution of their primary food source, seals, is influenced by ice conditions and water depth (Stirling, 1990). Between 1967 and 1992, the population grew about two percent per year and may have reached carrying capacity (Amstrup, 1995). Approximately 1,800 polar bears occur in the Beaufort Sea (USF&WS, 1998a). Based on radio collar surveys, the Beaufort Sea population dens locally, and is not dependent on reproduction from other known denning areas outside of the region (Amstrup & Gardner, 1994).

Polar bears breed during April and May and males travel long distances during this time, searching for females. When a male finds a female, he stays with her a few days, breeds and then goes off in search of another. During early November and December, the pregnant females search out deep snow drifts in which to dig their dens (ADF&G, 1994).

The Jones Island group, other barrier islands, and certain coastal areas are important for maternity denning polar bears (Bright, 1992). A denning female excavates a depression in the snow under a bank, on a slope, or near rough ice. She enlarges the denning chamber as drifting snow accumulates in depth. Pregnant

females choose denning areas that have enough topographic relief and the proper slope aspect (south-facing) to catch and hold snow banks under a variety of autumn conditions. In the Beaufort Sea, these conditions appear to be most common on the mainland near the coastline and along rivers where sharp banks accumulate snow. Most dens found on land in Alaska have been less than 6 miles from the coastline, although some occurred up to 36 miles inland (MMS, 1993:8-9).

Denning occurs on both land and on sea ice with about half occurring on each. Bears that den on the ice may drift up to 600 miles during the winter. Biologists had earlier thought that pregnant females returned to the same den and thus the specific location of known dens was important for pre-application development planning. However, research indicates that bears do not den in the same place, but are only faithful to the general substrate and geographic area upon which they had previously denned: on ice or on land, and in the eastern or the western Beaufort respectively. The most preferred region for land denning is located immediately onshore, south of the sale area in the northeast corner of Alaska (Amstrup, 1995:291-293).

Cubs are born during December and January. Normally the female has two cubs. The average female may produce only one or two litters during her life. Thus, few cubs are produced to replace bears that die. Temperatures in the den are usually much higher than outside, and the cubs could not survive without the shelter of the den and their mother's care. They make short trips to and from the open den for several days as the cubs become acclimated to outside temperatures. They then start traveling on the drifting sea ice (ADF&G, 1994). The mother does not eat while denning; both she and her cubs live off her fat reserves. They stay in their dens all winter, but they can be aroused from their dens by disturbance (MMS 93-0008:8-9). Female bears and cubs emerge from dens in late March or April, and may remain near their dens for up to 15 days. Bears and cubs move onto the sea ice during summer. Cubs stay with their mother for about 28 months. Upon separation she usually breeds again. Litters are produced generally every three to four years (ADF&G 1985a:78).

The main food of polar bears in Alaska is the ice-inhabiting ringed seal. Bears capture seals by waiting for them at breathing holes and at the edge of leads or cracks in the ice. They also stalk seals resting on top of the ice and catch young seals by breaking into pupping chambers on top of the ice in the spring (ADF&G, 1994). Hunting polar bears concentrate near open leads in winter. An important habitat zone in the eastern Beaufort Sea is the seaward edge of the landfast ice, corresponding roughly with the 66-ft. isobath (Stirling, 1990). Bears have difficulty catching seals in open water. A polar bear has to catch approximately one seal a week to maintain itself. Bears can eat up to 10 percent of their body weight in 30 minutes. The stomach of a large bear may hold up to 200 pounds of food. Other sources of food include walruses, small whales, birds, seaweed, eggs, berries, lemmings, shrubs, lichens, and grass and occasionally other polar bears and humans (MMS, 1993:5).

Polar bears scavenge many things including animal carcasses (especially whales), garbage, and food caches. They chew on and may eat a variety of manufactured items, including rubber, plastic, rope, canvas, motor oil, snow machine seats, chemicals, and batteries (MMS, 1993:5).

## b. Bowhead Whales

Bowhead whales (*Balaena mysticetus*) are the only baleen whales that spend their entire lives near sea ice and do not migrate to warmer waters to calve (ADF&G, 1994). They are on the Endangered Species List and are currently protected under both the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Currently, the Western Arctic bowhead stock population is healthy at 8,200 animals and is growing at a rate of 3.2 percent each year (NMFS, 1998).

Bowheads are well adapted for living in arctic waters. They have very thick blubber, up to 1-1/2 ft., which is used for insulation, food storage, and padding, and heavy bone structure in their skulls for breaking ice. The upper jaw is arched upward, and paired blowholes are located at the peak of the elevated "crown." This large, bow-shaped head distinguishes bowheads from other whales (ADF&G, 1994).

Bowheads often depend for survival upon their ability to travel through icy waters. Researchers have detected bowheads traveling through lead systems that appear to be completely covered by ice. When

bowheads cannot find open water, they push up ridges in thin ice or break holes in ice up to 2 ft. thick (ADF&G, 1994). Whaling crews report that bowheads commonly break ice greater than 20 cm (George, et al., 1989).

Bowhead whales are very vocal and use underwater sounds to communicate while traveling, feeding, and socializing. Some bowheads produce long repetitive songs which may be related to mating display (ADF&G, 1994). Underwater sounds may also be used in navigating. Bowhead whales are sensitive to industrial noise, and most individuals avoid noise sources. Sensitivity to noise is a subject of intense interest, research, and debate as it affects subsistence whaling and oil and gas operations. “The major sources of noise to which bowheads are exposed are aircraft and ship traffic, ice-breaking seismic exploration, marine construction, and offshore drilling.” (Rexford, 1995:V-117)

Estimating the distribution and behavior of bowhead whales is accomplished in many ways. For centuries, whales have been observed from shore at Point Barrow, and subsistence hunters have observed bowhead behavior at sea and at the edge of the ice pack. Federal researchers have been counting whales with aerial surveys and radio telemetry tracking devices attached to the whale.

Each spring the bowhead whales migrate from the central and western Bering Sea through the Chukchi Sea, pass Point Barrow, and swim through the Alaskan sector of the Beaufort Sea to summer feeding grounds in the Beaufort Sea north of Canada's Mackenzie River delta. Some whales may travel west and spend their summer in the Siberian Chukchi Sea (Frost & Lowry, 1984). Generally, spring migratory routes are concentrated far offshore in the open ice leads as much as 100 miles offshore (Fraker, 1984). Beluga whales have been observed following bowheads during the spring migration (Pederson, M., 1995:V-124).

In the fall the bowheads return to the Bering Sea for the winter and must pass back through the Chukchi Sea to get there (See Figures 3.4.A - C). Bowheads only spend about five percent of the time at the surface, and it has been estimated that only 13 percent of whales could be seen from the air (Mate and Krutzikowsky, 1995). The median depth at which whales are observed during their fall migration is a possible indicator of the axis of the migratory path. The historical observed median depth of bowhead whales is depicted for the three regions of the Bowhead Whale Aerial Survey Program (BWASP). Region One extends offshore from just west of Pitt Point to Oliktok Point. Region Two extends offshore from Oliktok Point to Flaxman Island. Region Three extends offshore from Flaxman Island to the Canadian Border.

The median depth at which bowhead whales were sighted varied over the years. Considering all observations between 1982 and 1996, BWASP researchers are 99 percent sure that the median depth at which whales were observed during the fall migration was between 50 and 121 ft. for region One. For Region Two, that confidence interval is 79 to 125 ft. For Region it’s between 131 and 151 feet (MMS, 1997). Earlier MMS research found that the migratory path occurred in waters between 60 and 150 ft. deep (Fraker, 1984:50). Other observations corroborate BWASP findings (Ljungblad, et al., 1987)(Hickie & Davis, 1983). Bowhead whales generally avoid waters between the barrier islands and the mainland.

The relationship between heavy ice and dive behavior is a focus of interest. Mate and Krutzikowsky (1995) noted that a tagged bowhead had longer and less frequent dives, spent more time at the surface, and foraged for food in deeper water, during a year of heavy ice. Their results “suggest that the heavy ice front may be the principle migratory cue for navigating across the Chukchi Sea.” (Mate and Krutzikowsky, 1995).

Whalers have observed bowheads further offshore in years when ice cover was heavy (George, 1995:V-138). Whales probably detect that a heavy ice season is imminent, and are in more of a hurry to get passed Point Barrow before freeze-up. They would naturally spend less time feeding during the fall migration, and choose more of a straight line course from the MacKenzie Delta-Banks Island feeding grounds to Point Barrow if signs of an early winter, and early freezing of the Chukchi Sea, were evident. Coincident with varying degrees of ice cover, the path (and pace) of the migration may be simply a function of food availability along the continental shelf. At Kaktovik, whalers observe bowheads feeding between Demarcation Point and Icy Reef and on the west side of Barter Island. Whalers note that bowheads feed near currents and currents change from year to year. In 1997, the current ran about 10 miles off the coast at Kaktovik (LGL, 1998:F-19).

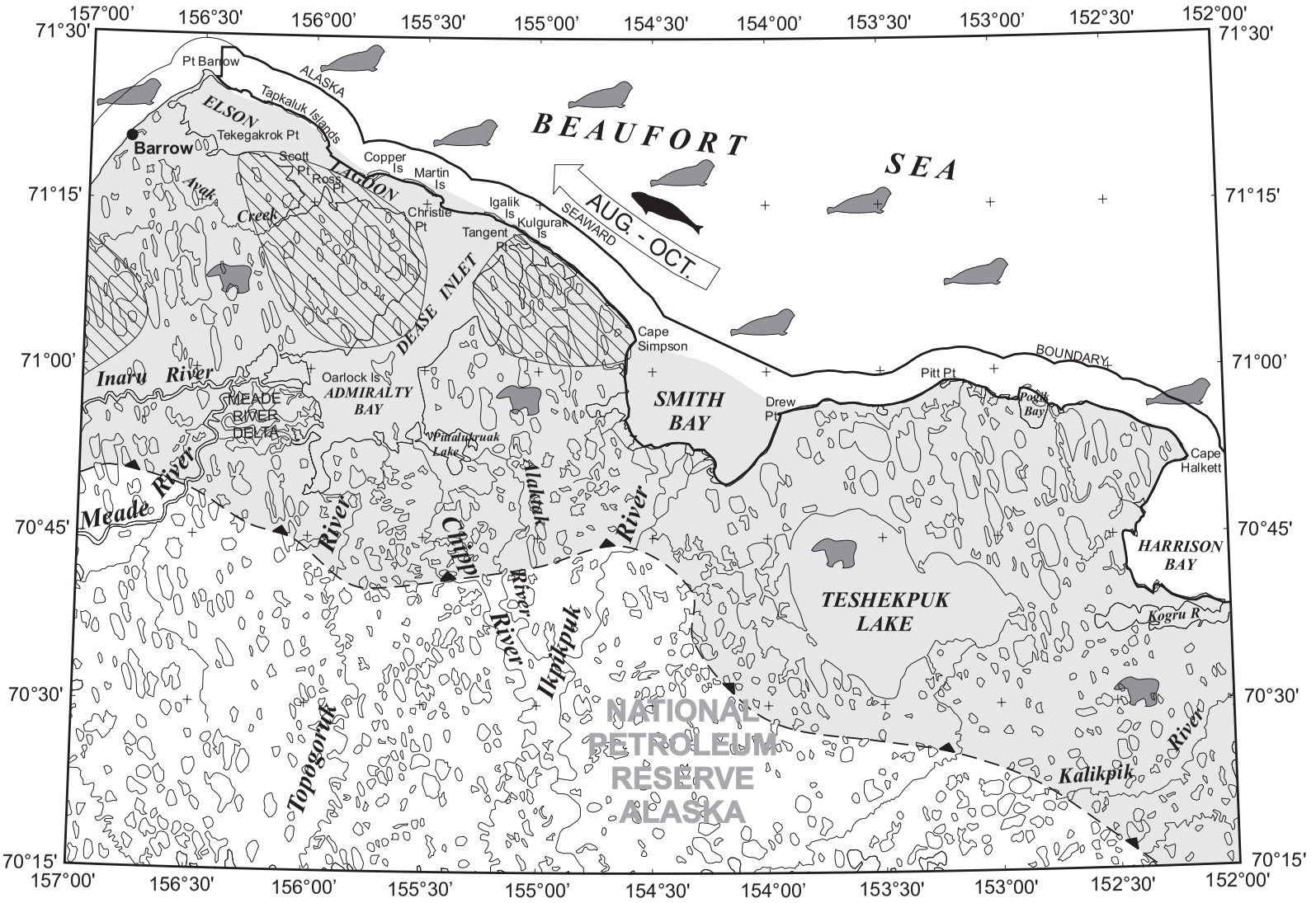
Bowheads feed at all depths, from the surface to the bottom. They feed by swimming with their mouths open and straining zooplankton out of the water with their baleen. Their primary foods are copepods, euphausiids, and other invertebrates. They have very large mouths to maximize the amount of water taken in and to hold captured food (ADF&G, 1994).

Important feeding areas include the Plover Islands (Ott, 1998:4), Herschel Island in Canada, Demarcation Bay (Mate and Krutzikowsky, 1995), and from Camden Bay to Banks Island (Fraker, 1984). During aerial surveys of bowheads in October 1992, surveyors encountered a large group of feeding bowheads about 35 kilometers northeast of Barrow. Most whales were observed between the 10 and 20-meter isobath. While the area is of periodic importance for feeding migrating whales late in the year, not all whales were seen feeding (Landino, et al., 1994).

The importance of the eastern Beaufort Sea (139º-146ºW) as a feeding area is the subject of a study currently being conducted by the MMS (1998a). Abundance of bowheads within this feeding area was the subject of 22 studies between 1979 and 1997. "Richardson (1987) estimated that the eastern Alaskan Beaufort Sea provided less than two percent of the total annual food requirements for bowheads …" However, the NSB rejected this conclusion. Review of the survey data may indicate feeding areas have moved geographically over time. "Six of the seven years with above-average bowhead abundance were in the 1990s and most (9 of 11) of the years with below-average abundance occurred prior to 1990. Thus there has apparently been a general and notable increase in bowhead abundance in the study area since 1990." (LGL, 1998:11) Research may show local oceanographic conditions increase or decrease the availability of bowhead prey items in traditional whaling areas.

A study of the food whales may be eating was conducted during 1980-1988 in the eastern Alaskan Beaufort Sea, and in Canadian waters off the Mackenzie Delta and Tuktoyaktuk Peninsula. Copepods were the dominant zooplankton with *Limnocalanus macrurus* more plentiful at nearshore sampling stations in the eastern Alaskan Beaufort Sea. Stomach content sampling conducted by ADF&G between 1969 and 1997 show variability in the diet of bowhead whales from the east to the west. Whales in the western Beaufort Sea fed primarily on euphausids, whereas whales harvested in the eastern Beaufort Sea fed primarily on copepods (LGL, 1998:16-17).

Mating probably occurs during late winter and spring. The gestation period is 13 to 14 months. Calving extends from late May to early August. Newborns must begin swimming north with the migrating herd almost immediately (ADF&G, 1994).




## Important Marine Mammal Habitat

**Bowhead Whale**
Known Migration Patterns
AUG. - OCT.

**Polar Bear**
General Distribution
Potential Denning Area
Confirmed Coastal Denning Area

**Ringed Seal**
General Distribution
Breeding And Pupping Along Shore-fast Ice

**Sale Area**

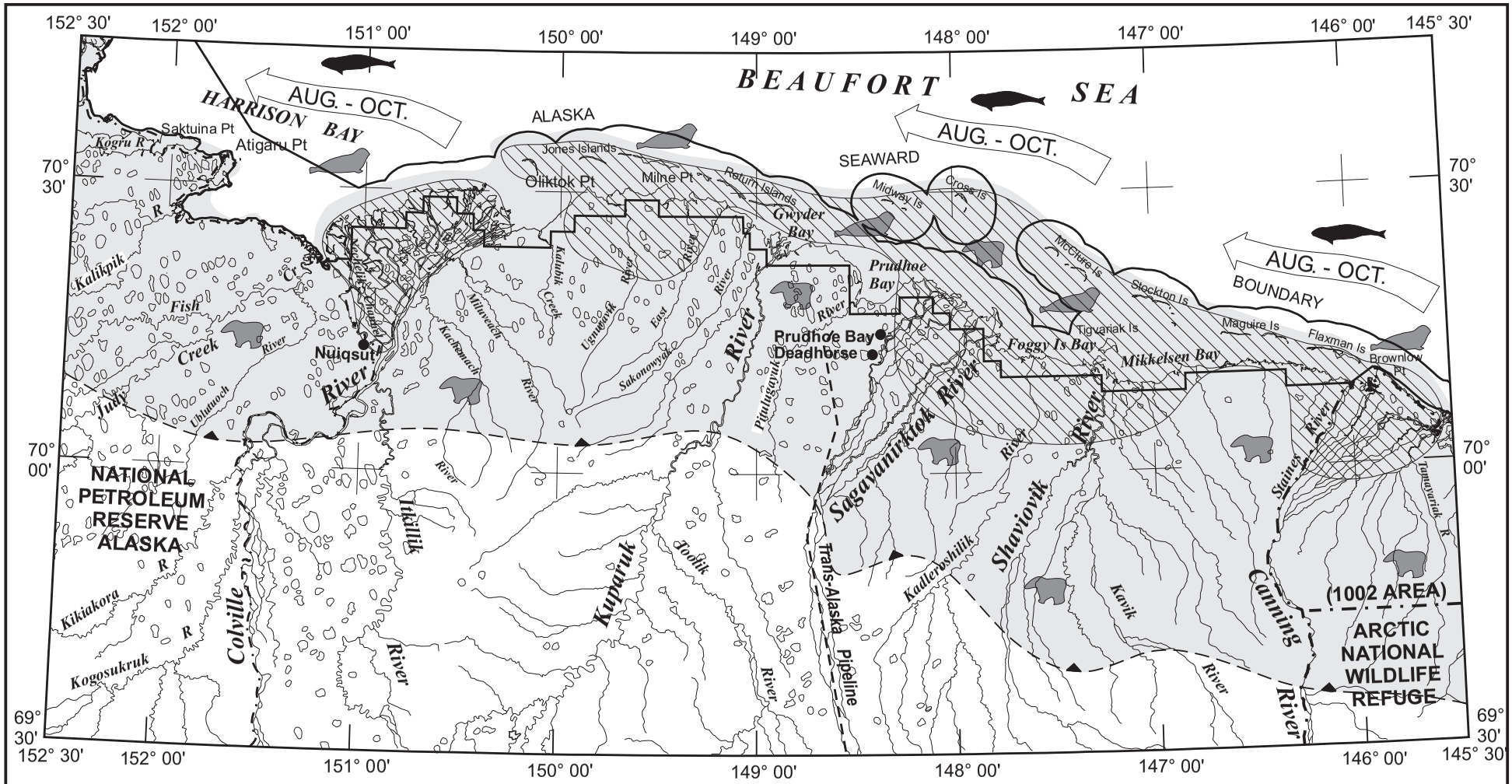
MAP AREA

SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.
20 MILES 0 20 40 MILES

Source: ADNR, 1995.
ADF&G 1986.

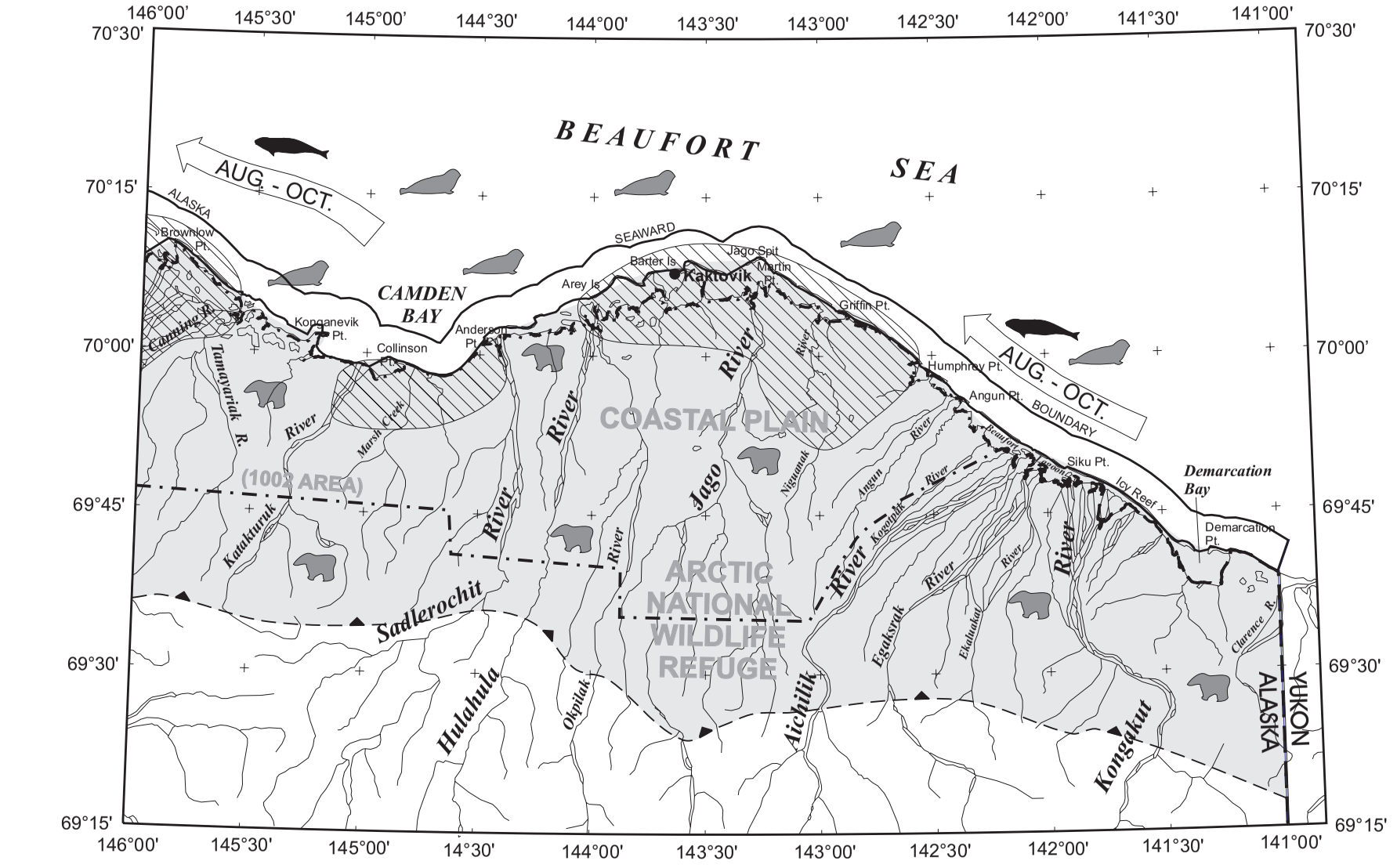
ADNR 5/7/99

**FIGURE 3.4.A**

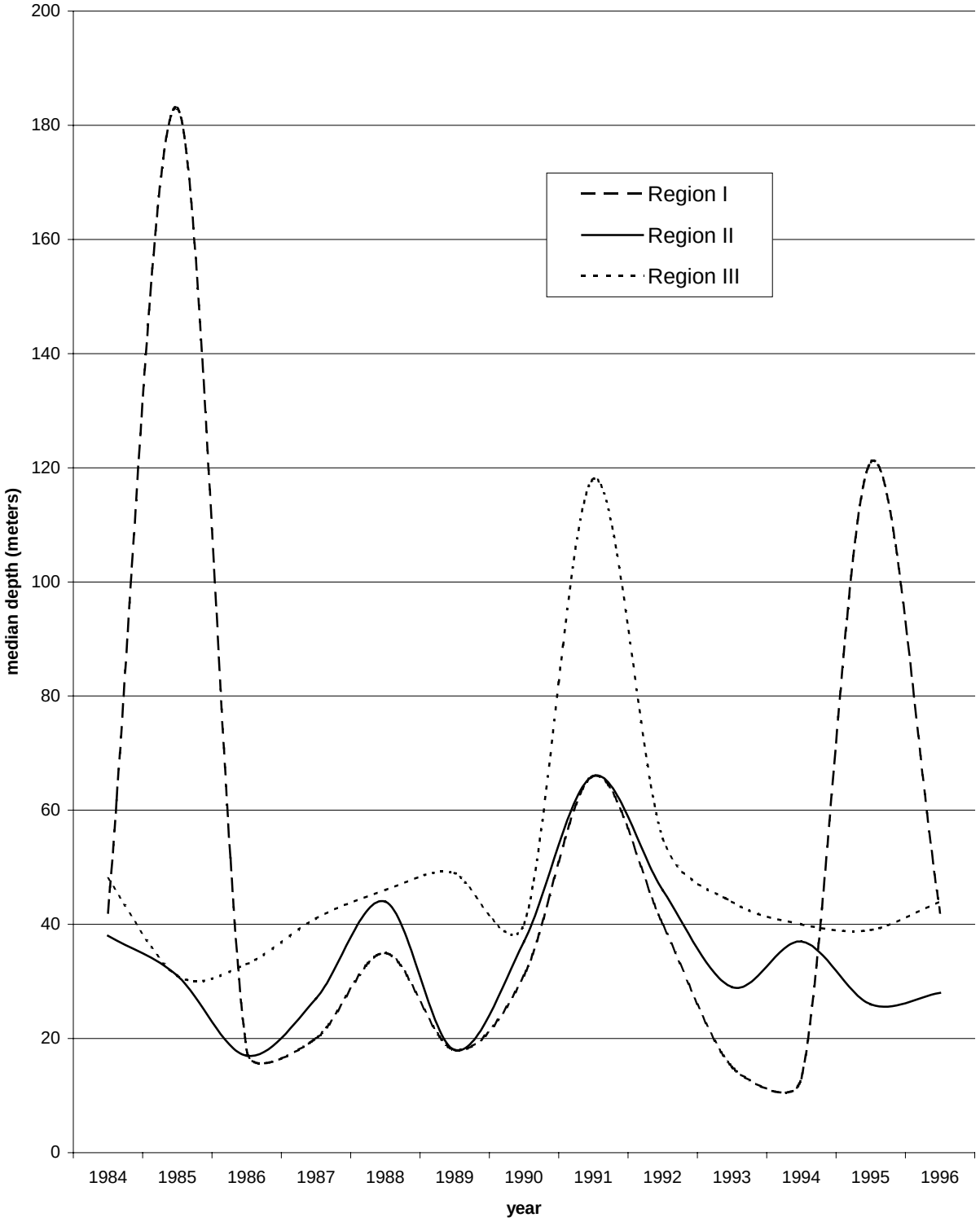



ADNR 5/7/99

**FIGURE 3.4.B**


146°00'
145°30'
145°00'
144°30'
144°00'
143°30'
143°00'
142°30'
142°00'
141°30'
141°00'
70°30'
70°15'
70°00'
69°45'
69°30'
69°15'
BEAUFORT SEA
AUG. - OCT.
ALASKA
Brownlow Pt.
SEAWARD
CAMDEN BAY
Barter Is.
Jago Spit
Martin Pt.
Kaktovik
Arey Is.
Griffin Pt.
Konganevik Pt.
Collinson
Anderson Pt.
Humphrey Pt.
Angun Pt.
BOUNDARY
Siku Pt.
Icy Reef
Demarcation Bay
Demarcation Pt.
Canning R.
Tamayariak R.
Marsh Creek
Kataktuvuk River
Sadlerochit
Hulahula
Okpilak
Jago
Niguanak
Angun
Kogotluk
Egaksrak
Ekaluakat
Aichilik
Kongakut
Clarence R.
YUKON
ALASKA
COASTAL PLAIN
(1002 AREA)
ARCTIC NATIONAL WILDLIFE REFUGE
Important Marine Mammal Habitat
Bowhead Whale
Known Migration Patterns
AUG. - OCT.
Polar Bear
General Distribution
Potential Denning Area
Confirmed Coastal Denning Area
Ringed Seal
General Distribution
Breeding And Pupping Along Shore-fast Ice
Sale Area
MAP AREA
SCALE 1:1,000,000 ONE INCH = 16 MILES APPROX.
20 MILES
0
20
40 MILES
Source: ADNR, 1995.
ADF&G 1986.
ADNR 5/7/99
FIGURE 3.4.C

**Median depth of Random Bowhead Whale Sightings during September - October 1982-1996**




Source: MMS 97-0016: 56-57

## c. Ringed Seals

Ringed seals (*Phoca hxspida*) are a species of the pinniped family, which also includes spotted seals and walrus. Pinna, means a wing or fin; and pedts, a foot. Pinnipeds are protected under the Marine Mammal Protection Act of 1972. Ringed seals are the smallest of the pinnipeds and are the most abundant seal in the Beaufort Sea (ADF&G, 1994).

Activities of ringed seals on the ice vary with the seasons of the year. During the late spring and early summer, ringed seals use the ice as a solid surface on which to haul out and complete their annual molt. They are usually found near cracks, open leads or holes where they have rapid access to water. During winter and spring, most of the breeding adults are found on stable land-fast ice. From March through May, during the spring breeding and pupping season, high densities of adults remain on the land-fast ice while subadults are most numerous in adjacent flow ice zones (LaBelle et al., 1983). See Figures 3.4.A - C. Ringed seals live on or near the ice year-round, therefore the seasonal ice cycle has an important affect on their distribution and abundance in the sale area. Male ringed seals may be territorial during the breeding season (ADNR, 1992:22).

Females give birth to a single, white-coated pup in snow dens on either landfast or drifting pack ice during March and April. Female seals build lairs in pressure ridges or under snowdrifts for protection from predators and severe weather. There is some evidence that females lacking maternal experience give birth in marginal habitat—drifting pack ice—and may be more subject to polar bear predation. More experienced females give birth in the better habitat--landfast ice—and may have higher reproductive success (ADNR, 1992:22).

Ringed seals molt in May and June. During this time they spend long periods hauled out on the ice basking in the sun. It is thought that warmer skin temperatures cause the new hair to grow more quickly. When hauled out on the ice, ringed seals are very wary, raising their heads every 20 seconds or so to look around. They rapidly enter the water when they detect an approaching human or other predator (ADF&G, 1994).

The amount of time spent on the ice increases as the molt season progresses. In summer, as the nearshore ice melts, most of the adult ringed seals are found along the edge of the pack ice, seaward of the sale area. Subadults may remain in the ice free areas. Open leads and cracks in the ice are used by ringed seals to surface and breathe. During the fall as freeze-up begins, seals will actively keep breathing holes open (ADNR, 1992:22)(Stirling, 1990).

Ringed seals spend much of the summer and early fall in the water feeding. Ringed seals eat a variety of invertebrates and fish. The particular species eaten depends on availability, depth of water, and distance from shore. In Alaska waters, the important food species are Arctic cod, saffron cod, shrimps, and other crustaceans. Feeding is greatly reduced during the molt (ADF&G, 1994).

## d. Spotted Seal

The spotted seal (*Phoca largha*) is commonly seen in coastal waters of northern Alaska during ice-free seasons. The name is descriptive of its markings, consisting of numerous dark, irregularly shaped spots (sometimes encircled by a faint ring) on a lighter background, usually of a brownish yellow color. Spots are most numerous on the back and upper flanks (ADF&G, 1994).

Spotted seals enter the sale area in July and are known to haul-out on the outer islands of the eastern Colville River Delta. They move out of the Beaufort Sea from September to mid-October as the shorefast ice reforms (Ott, 1997).

They are annual breeders, and mating occurs in late April to early May. Pupping occurs anytime from early April to the first part of May, although the peak is during the first two weeks of April. Pups are nursed for three to four weeks, during which time they more than double in weight. Adult females mate about the same time their pups are weaned (ADF&G, 1994).

They eat a varied diet; principal foods are schooling fishes, although the total array of foods is quite varied. There are geographical and seasonal differences in their prey. Along the coast spotted seals feed on herring, capelin, saffron cod, some salmon (especially in lagoons and river mouths) and smelt (ADF&G, 1994).

## e. Bearded Seal

The bearded seal (*Erignathus barbatus*) is the largest seal normally found in the seas adjacent to Alaska. The majority of the bearded seal population in Alaska is in the Bering and Chukchi seas. In the Beaufort Sea the bearded seal is primarily restricted to moving ice during the summer (MMS, 1996: III-B-7). Bearded seals generally occur in the Beaufort Sea from July through October, and are primarily associated with the pack ice edge (Ott, 1997).

The ability to conceive successfully usually occurs when females are 5 or 6 years old. Males become sexually mature at 6 or 7 years. Bearded seals commonly become reproductively active before they attain maximum growth. The incidence of pregnancy in adult females is about 85 percent, and the sex ratio of Alaska samples consistently show slightly more females in the population. During April, adult males begin underwater "singing." The song is a highly characteristic and complex frequency modulated whistle, parts of which are audible to humans. Hunters are sometimes guided to a seal by its whistle (ADF&G, 1994).

Females bear a single pup, usually during late April or early May. The average weight of pups at birth is around 75 pounds and average length is about 52 inches. By the end of a brief nursing period, lasting from 12 to 18 days, pups increase their weight almost three times, to around 190 pounds. This gain is due mainly to an increase in thickness of the blubber layer (ADF&G, 1994).

Bearded seals eat a wide variety of invertebrates and some bottom fishes. The main food items are crabs, shrimp, clams, and snails (ADF&G, 1994).

## f. Walrus

Pacific walrus are the largest pinnipeds in Arctic and subarctic seas. The majority of the North Pacific walrus population occurs west of Barrow, although a few walrus may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open water season. They are most commonly found in relatively shallow water areas, close to ice or land. The genus name for the walrus, *Odobenus* (meaning tooth-walker), refers to one of their most prominent characteristics, their tusks. These tusks, which are elongated upper canine teeth, are present in both males and females. They are huge animals; adult bulls often approach 2 tons in weight, and the females may exceed one ton (ADF&G, 1994).

Most females do not begin to breed until 6 or 7 years of age. Mating occurs during January and February, but growth of the fetus does not begin until about mid-June. This delay in fetal growth is thought to occur in all pinnipeds. Walrus calves are born mostly in late April or early May during the spring migration. They weigh 100 to 160 pounds at birth. Calves are dependent upon their mothers for at least 18 months and occasionally for as long as 2-1/2 years (ADF&G, 1994).

Cows will not abandon their calves, and vice versa. The cows make every effort to rescue their offspring. They often carry their dead calves away from the hunters. Walruses, especially young males, will push dead and badly wounded animals (often larger than themselves) off an ice floe, out of the reach of the hunters (ADF&G, 1994).

Walruses feed mainly on bottom dwelling invertebrates. Major food items include several different kinds of clams. The rejected shells can be found on the sea floor alongside the holes and furrows made by feeding animals. Other food items include snails, crabs, shrimps, worms, and occasionally seals. Walruses usually find food by brushing the sea-bottom with their broad, flat muzzles. The tusks are probably not used to any great extent during feeding (ADF&G, 1994).

# C. References

ACMP
1985 Biophysical Boundaries for Alaska's Coastal Zone. Alaska Coastal Management Program, Division of Governmental Coordination, Office of Management and Budget.

ADF&G (Alaska Department of Fish and Game, Habitat Division)
1984 Fish and Wildlife Resources of the Colville River Delta, Habitat Division—Region IV, January.
1985a Alaska Habitat Management Guide, Southcentral Region, Volume I, "Life Histories and Habitat Requirements of Fish and Wildlife."
1985b Alaska Habitat Management Guide, Arctic Region, Volume II: Distribution, Abundance, and Human Use of Fish and Wildlife. Division of Habitat, Juneau.
1994 Wildlife Notebook Series
1996 Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes, Arctic Region, Resource Management Region V. Alaska Department of Fish & Game, Habitat Division.
Undated The Western Arctic Caribou Herd: Has it Peaked? Alaska Department of Fish & Game, Division of Wildlife Conservation, Information Leaflet.

ADN
1996 Biologists seek OK to thin Nelchina caribou herd. Anchorage Daily News, March 27; B3.

ADNR (Alaska Department of Natural Resources, Division of Oil and Gas)
1988 Final Finding and Decision of the Director Regarding Oil and Gas Lease Sale 55, Demarcation Point, April 25.
1990 Final Finding and Decision of the Director Regarding Oil and Gas Lease Sale 70A, Kuparuk Uplands, September 13.
1992 Final Finding of the Director Regarding Oil and Gas Lease Sale 68, Beaufort Sea, February 25.
1991 Final Finding of the Director Regarding Oil and Gas Lease Sale 65, Beaufort Sea, February 26.
1996 Final Finding of the Director Regarding Oil and Gas Lease Sale 86A, Colville River Exempt, May.

Amstrup, Steven C.
1995 Movements, Distribution, and Population Dynamics of Polar Bears in the Beaufort Sea. Steven C. Amstrup, Ph.D. dissertation, University of Alaska Fairbanks, May.

Amstrup, Steven C. & Gardner, Craig
1994 Polar Bear Maternity Denning in the Beaufort Sea. Steven C. Amstrup and Craig Gardner, Alaska Fish and Wildlife Research Center, USFWS, in Journal of Wildlife Management, Vol. 58(1), pp. 1-10.

Baker, Bruce
1987 Memorandum from Acting Director, Habitat Division, ADF&G, to Jim Eason, Director, DO&G, regarding Sale 54, February 24.

Bergman, Robert D. et. al
1977 Waterbirds and Their Wetland Resources in Relation to Oil Development at Storkersen Point, Alaska. USF&WS Resource Publication 129.

Bright, Larry
1992 Letter from Larry K. Bright, Acting Field Supervisor, USFWS, Northern Alaska Ecological Services, to James Hansen, DO&G, August 21.

Burgess, R.M., and Ritchie, R.J.
1988 Snow Goose Monitoring Program, 1987 Endicott Development Project. Draft Report by Envirosphere Company, for U.S. Army Corps of Engineers, Anchorage.

Carroll, Geoff
1996 Personal communication with Geoff Carroll, Area Biologist, Alaska Department of Fish and Game to Brian Havelock, DO&G, May 5.

Cowardin, L.M., Carter, V., Golet, F.C., and LaRoe, E.T.
1979 Classification of Wetlands and Deepwater Habitats of the United States. USDOI, USFWS, FWS/OBS-79/31.

Craig, et al.
1984 Trophic Dynamics in an Arctic Lagoon. Peter C. Craig, William B. Griffiths, Stephen R. Johnson, LGL Limited, and Donald M. Schell, Institute of Water Resources, University of Alaska Fairbanks, in The Alaskan Beaufort Sea: Ecosystems and Environments, Peter Barnes, Donald Schell, and Erk Reimnitz, eds., Academic Press, Inc., pp. 347-380.

Craig and Haldorson
1981 Beaufort Sea Barrier Island-Lagoon Ecological Processes Studies: Final Report, Simpson Lagoon, Part 4, Fish. Environmental Assessment of the Alaskan Continental Shelf, Final Reports of Principal Investigators, RU 467, Vol. 7, Biological Studies. Boulder, CO. USDOC, NOAA, OCSEAP, and USDOI, BLM, pp. 384-678.

Cronin, M., Ballard, W., Truett, J., and Pollard, R.
1994 Mitigation of the Effects of Oil Field Development and Transportation Corridors on Caribou. Final Report to the Alaska Caribou Steering Committee, LGL Alaska Research Associates, Inc., July.

Dunton, Kenneth H.
1984 An Annual Carbon Budget for an Arctic Kelp Community. Kenneth H. Dunton, Institute of Water Resources, University of Alaska Fairbanks, in The Alaskan Beaufort Sea: Ecosystems and Environments, Peter Barnes, Donald Schell, and Erk Reimnitz, eds., Academic Press, Inc., pp. 311-325.

Fraker, Mark A.
1984 Balaena mysticetus: Whales, Oil, and Whaling in the Arctic. Mark A. Fraker, Environmental Affairs Department, Sohio Alaska Petroleum Company, and Patricia E. Starratt, Ed., Sohio Alaska Petroleum Company, Anchorage.

Frost, Kathryn J., and Lowry, Lloyd, F.
1984 Trophic Relationships of Vertebrate Consumers in the Alaskan Beaufort Sea. Kathryn J. Frost and Lloyd F. Lowry, Alaska Department of Fish and Game, in The Alaskan Beaufort Sea: Ecosystems and Environments, Peter Barnes, Donald Schell, and Erk Reimnitz, eds., Academic Press, Inc., pp. 381-401.

George, Craig
1995 Testimony on Proposed OCS Lease Sale 144 at a Public Hearing in Barrow, November 8, 1995. In Beaufort Sea Planning Area, Oil and Gas Lease Sale 144, Vol. 2, Final EIS, OCS EIS/EA, MMS 96-0012, p. V-138.

George, et al.
1989 Observations on the Ice-Breaking and Ice Navigation Behavior of Migrating Bowhead Whales (Balaena mysticetus) near Point Barrow, Alaska, Spring 1985. John C. George, Department of Wildlife Management, NSB; Christopher Clark, Laboratory of Ornithology, Cornell University; Geoff M. Carroll, Department of Wildlife Management, NSB; and William T. Ellison, Marine Acoustics, in Arctic, Vol. 42, No. 1, p.24-30.

Gertler, Paul, E
1988 Letter from Field Supervisor, USF&WS, to Pam Rogers, DO&G regarding proposed Sale 65, June.

Hickie, J. & Davis, R.A.
1983 Distribution and Movements of Bowhead Whales and Other Marine Mammals in the Prudhoe Bay Region, Alaska. In Biological Studies and Monitoring at Seal Island, Beaufort Sea, Alaska, B.J. Galloway, ed., Unpublished Report by LGL Alaska Research Associates, Inc.

IPCB (International Porcupine Caribou Board)
1993 Sensitive Habitats of the Porcupine Caribou Herd, January.

Horner, Rita
1984 Phytoplankton Abundance, Chlorophyll *a*, and Primary Productivity in the Western Beaufort Sea. Rita Horner, in The Alaskan Beaufort Sea: Ecosystems and Environments, Peter Barnes, Donald Schell, and Erk Reimnitz, eds., Academic Press, Inc., pp. 295-310.

Johnson, Stephen R. and Hertler, Dale R.
1989 The Birds of the Beaufort Sea, Bridgetown Printing, June.

LaBelle, et al.
1983 Alaska Marine Ice Atlas, J .C. LaBelle, J. L. Wise, R. P. Voelker, R. H. Schulcz, and G. M. Whol Anchorage, Alaska, AEIDC.

Landino, et al.
1994 A Large Aggregation of Bowhead Whales (Balaena mysticetus) Feeding near Point Barrow, Alaska, in Late October 1992. S.W. Landino, S.D. Treacy, S.A. Zerwick, and J.B. Dunlap, In Arctic, Vol. 47, No. 3 (September 1994), p.232-235.

LGL
1998 Bowhead whale feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information: Denis H. Thompson and W. John Richardson, eds., LGL Limited, environmental research associates and LGL Ecological Research Associates, Inc. for Department of the Interior, Minerals Management Service, Draft Report, July 6.

Ljungblad, et al.
1987 Aerial Surveys of Endangered Whales in the Northern Bering, Eastern Chukchi, and Alaskan Beaufort Seas, 1986: With an Eight Year Review, 1979-1986. D.K. Ljungblad, S.E. Moore, J.T. Clarke, and J.C. Bennet. Technical Report 1435, Naval Ocean Systems Center, San Diego.

Mate, Bruce R. & Krutzikowsky, Gregory K.
1995 Tracking the Habits of Bowhead Whales with Satellite-Monitored Radio Tags. Bruce R. Mate and Gregory K. Krutzikowsky, Hatfield Marine Science Center, Oregon State University, in Proceedings of the 1995 Arctic Synthesis Meeting, OCS Study, MMS 95-0065.

Meehan, Rosa & Jennings, Thomas W.
1988 Characterization and Value Ranking of Waterbird Habitat on the Colville River Delta, Alaska. Rosa Meehan and Thomas W. Jennings, U.S. Fish and Wildlife Service, Alaska Investigations, prepared for U.S. EPA under Interagency Agreement #DW1493233-01-0, June.

MMS (Minerals Management Service)
1984 Final Environmental Impact Statement, Diapir Field Lease Offering, OCS Study MMS 84-0009, March.
1987 OCS-Final EIS, Beaufort Sea Sale 97, Volume 1, MMS 87-0089.
1993 Guidelines for Oil and Gas Operations in Polar Bear Habitats, Edited by Joe C. Truett, LGL Ecological Research Associates, MMS 93-0008, August.
1996a OCS Sale 144 Final Environmental Impact Statement, May.
1996b Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1995. Stephen D. Treacy, Research Manager, MMS Bowhead Whale Aerial Survey, OCS Study MMS 96-0006.

1997 Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1996. Stephen D. Treacy, Research Manager, MMS Bowhead Whale Aerial Survey, OCS Study MMS 97-0016.
1998a Alaska Annual Studies Plan, Final FY 2000-2001. Minerals Management Service, Alaska Outer Continental Shelf Region, December.
1998b Arctic Kelp Workshop Proceedings, May 12, Anchorage Alaska. MMS Alaska OCS Region, OCS Study MMS 98-0038, August.

NMFS (National Marine Fisheries Service)
1998 Alaska Marine Mammal Stock Assessments, 1998: Part Two Cetaceans. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-97, http://nmml.afsc.noaa.gov/library/publish.htm.

Niakuk Development Project, Environmental Assessment and Project Description
1988 Threatened and Endangered Species, May.

NSBCMP
1988 North Slope Borough Coastal Management Program. Maynard & Partch, Woodward-Clyde Consultants, April.
1984a North Slope Borough Coastal Management Program Background Report. Maynard & Partch, Woodward-Clyde Consultants.
1984b North Slope Borough Coastal Management Program Resource Atlas. Maynard & Partch, Woodward-Clyde Consultants, July.

O'Hara, Todd
1996 Personal Communication with Todd O'Hara, North Slope Borough, Department of Wildlife Management to Brian Havelock, DO&G, November 19.

Ott, Alvin G.
1991 Memorandum from Regional Supervisor, Department of Fish and Game, to James Hansen, Division of Oil and Gas, regarding Sale 64, Kavik, January 3.
1992 Memorandum from Regional Supervisor, Department of Fish and Game, to James Hansen, Division of Oil and Gas, regarding Sale 80, Shaviovik, April 27.
1997 Memorandum from Regional Supervisor, Habitat and Restoration Division, Alaska Department of Fish & Game, to James Hansen, Division of Oil & Gas, regarding Proposed Oil & Gas Lease Sale 86, April 1, 1997.
1998 Memorandum from Regional Supervisor, Habitat and Restoration Division, Alaska Department of Fish & Game, to James Hansen, Division of Oil & Gas, regarding Proposed Beaufort Sea Areawide 1999, June 15.

Pederson, Michael
1995 Testimony on Proposed OCS Lease Sale 144 at a Public Hearing in Barrow, November 8, 1995. In Beaufort Sea Planning Area, Oil and Gas Lease Sale 144, Vol. 2, Final EIS, OCS EIS/EA, MMS 96-0012, p. V-124.

Pollard, Robert, Walker, Kim-Marie, and Kenning, Erik
1992 Remote Sensing of Snow Goose Brood Rearing Habitat, Sagavanirktok River Delta, Alaska: 1990 Pilot Study Final Report. Prepared by LGL Alaska Research Associates, Inc. and AeroMap U.S. Inc., June.

Rexford, Burton
1995 Testimony on Proposed OCS Lease Sale 144 at a Public Hearing in Barrow, November 8, 1995. In Beaufort Sea Planning Area, Oil and Gas Lease Sale 144, Vol. 2, Final EIS, OCS EIS/EA, MMS 96-0012, p. V-117.

Smith, Louise, L.C. Byrne, C.B. Johnson, A.A. Stickney
1993 Wildlife Studies on the Colville River Delta, Alaska, 1993.

Sousa, Patrick
1992 USF&WS, letter to James Hansen, Division of Oil and Gas, regarding state Oil and Gas Lease Sale 80, April 29.
1995 USF&WS letter to James Hansen, Division of Oil and Gas, regarding the Preliminary Finding for Oil and Gas Lease Sale 80, April 14.
1998 USF&WS letter to James Hansen, Division of Oil and Gas, regarding the Preliminary Finding for Beaufort Sea Areawide 1999 Sale, June 12.

Stirling, Ian
1990 Polar Bears and Oil: Ecological Perspectives. Ian Stirling, Canadian Wildlife Service and Department of Zoology, University of Alberta, in Sea Mammals and Oil: Confronting the Risks, Joseph R. Geraci & David J. St. Aubin, eds., Academic Press, 1990.

Treacy, Stephen
1998 Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1997. Minerals Management Service, Alaska Region, OCS Study MMS 98-0059.

USACE (U.S. Army Corps of Engineers)
1984 Endicott Development Project, Final EIS.

USDOI, (U. S. Department of the Interior, USF&WS)
1986 Final Report Baseline Study of the Fish, Wildlife, and their Habitats, Section 1002C, Alaska National Interest Lands Conservation Act.
1987 ANWR, Coastal Plain Resource Assessment Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement. In accordance with Section 1002 of the Alaska National Interest Lands Conservation Act and the National Environmental Policy Act.
1987a Final EIS Beaufort Sea Sale 97, (MMS 87-0069) June.
1996 Final EIS Beaufort Sea Sale 144, (MMS 96-0012) May.
1996 Spectacled eider recovery plan, August.
1997 Northeast National Petroleum Reserve Draft Integrated Activity Plan/EIS, December.
1998 Final EIS Beaufort Sea Sale 170, (MMS 98-0007) February.
1998a Draft Alaska Marine Mammal Stock Assessment 1998 Sea Otters, Polar Bear and Walrus.

Viereck, L.A., Dyrness, C.T., Batten, A.R., and Wenzlick, K.J.
1992 The Alaska vegetation classification. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR, General Technical Report PNW-GTR-286.

Walker, D. A., and Weber, P.J.
1980 Vegetation. *In* Geobotanical Atlas of the Prudhoe Bay Region, Alaska, D.A. Walker, K.R. Everett, P.J. Weber, and J. Brown, ed., CRREL Report 80-14.

Whitten, Ken
1999 Personal communication from Ken Whitten, ADF&G, to Brian Havelock, DO&G, May 10.

Whitten, Kenneth R.
1995 Results of the 1995 Central Arctic Caribou Herd Photo-census. Memorandum from Kenneth R. Whitten, Acting Research Coordinator, ADF&G to Wayne Regelin, Director, Division of Wildlife Conservation, October 20.